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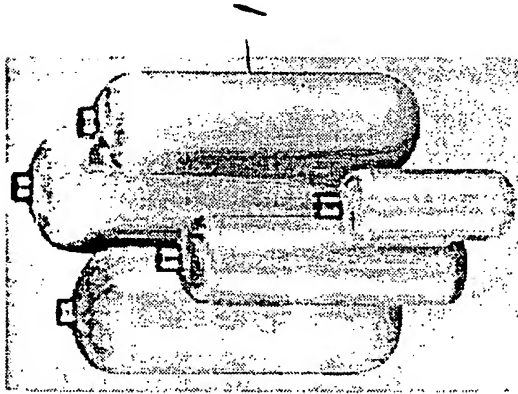


Fig. 1-1. S-2 glass-epoxy tanks

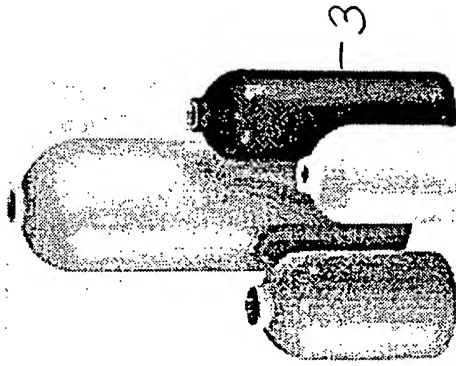


Fig. 1-3. Kevlar-Epoxy Tanks

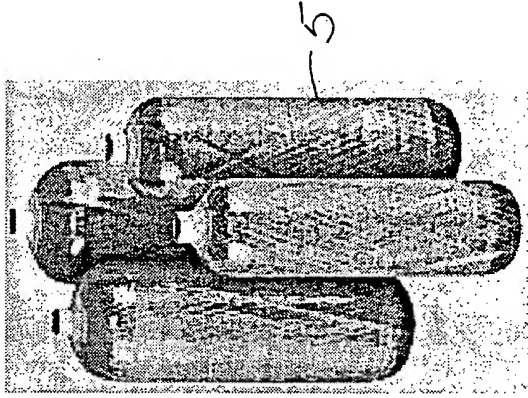


Fig. 1-5. Carbon-Fiber/Epoxy Tanks



Fig. 1-2. Medical Application

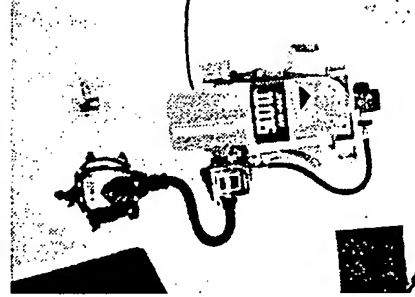


Fig. 1-4. Life Support Tank

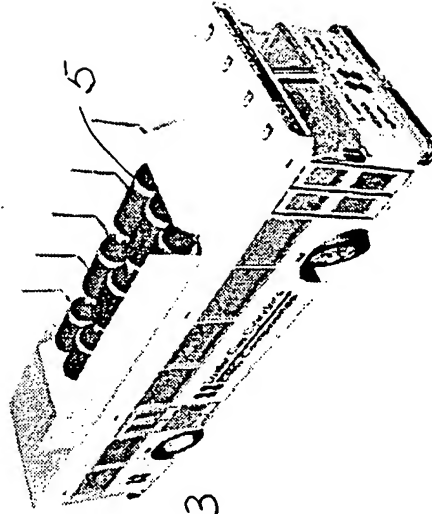
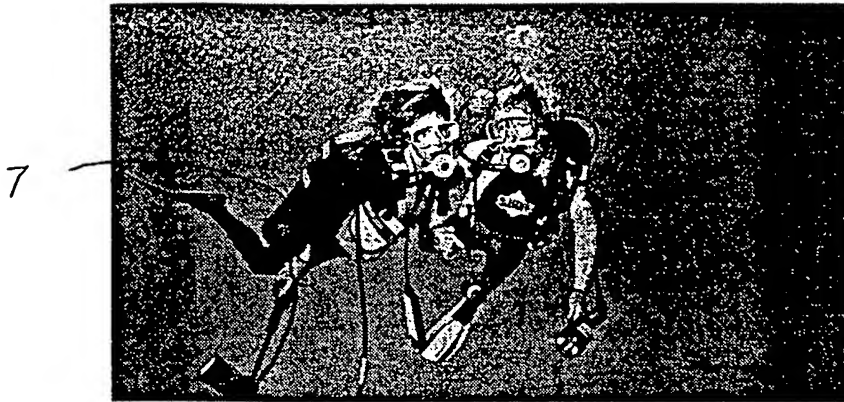
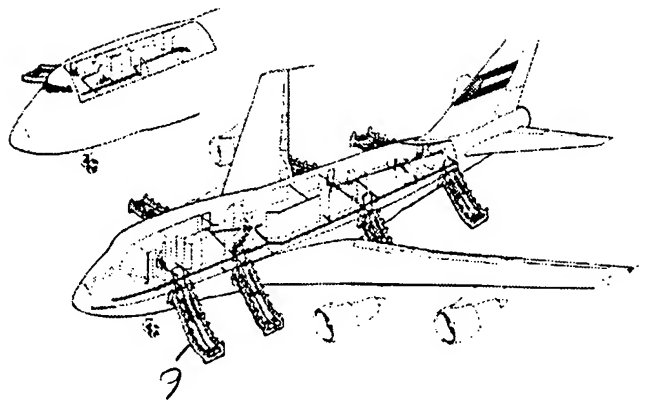


Fig. 1-6. Alternate Fuel Bus



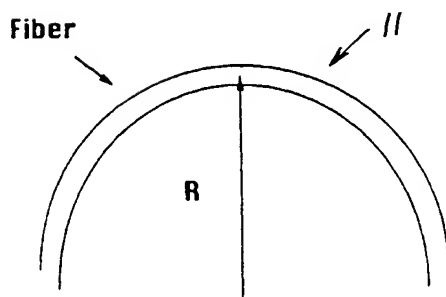
**Fig. 1-7. Carbon Fiber Tanks for Recreational SCUBA**



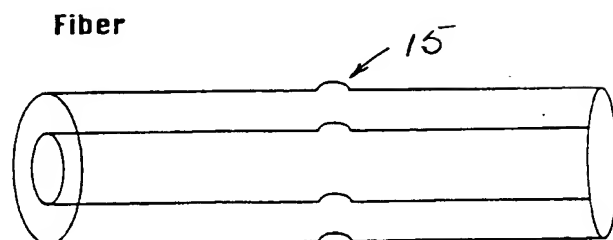
**Fig. 1-8. Gas-Actuated Escape Ramps**

**Macrobending**

**Microbending**



(a)



(b)

**Fig. 2-1. Macrobending versus Microbending**

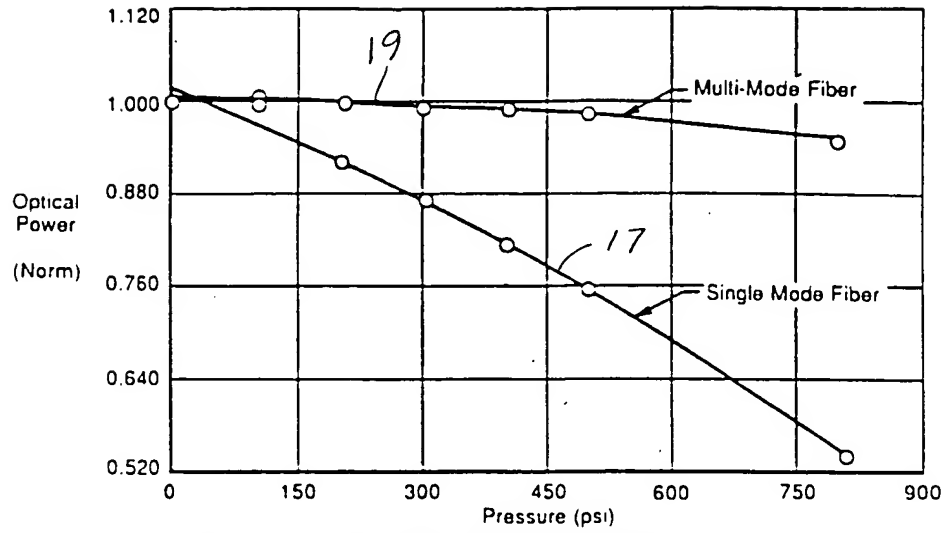


Fig. 2-2. Microbending Test Results

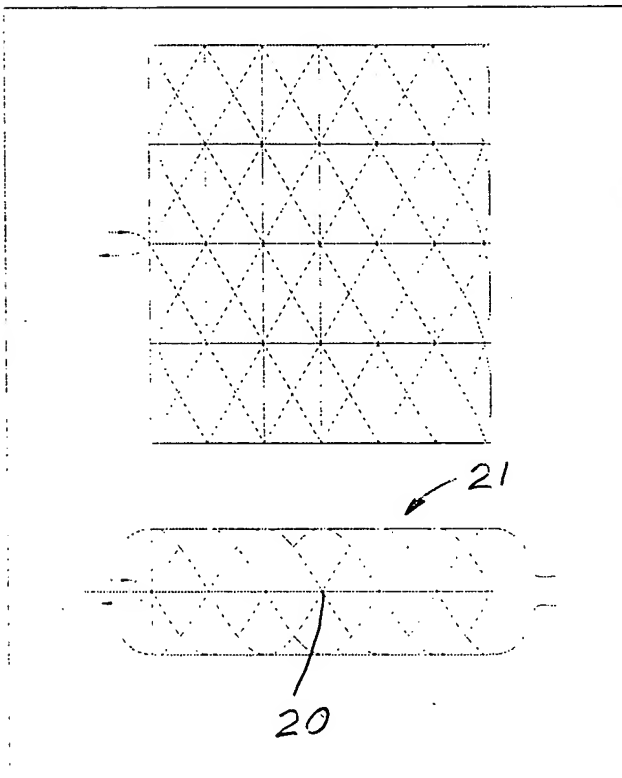


Fig. 2-3. 61° Two Layer Wrap with 52 Pinch Points

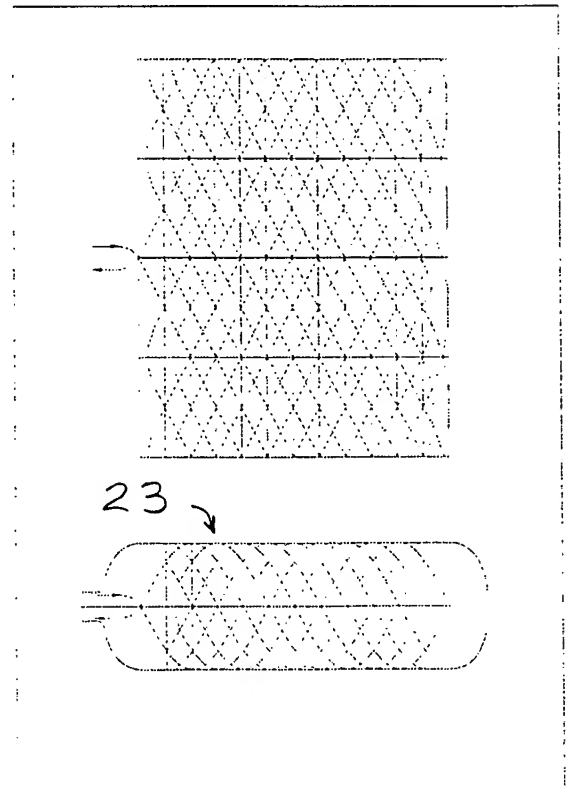


Fig. 2-4. 61° Four Layer Wrap with 202 Pinch Points

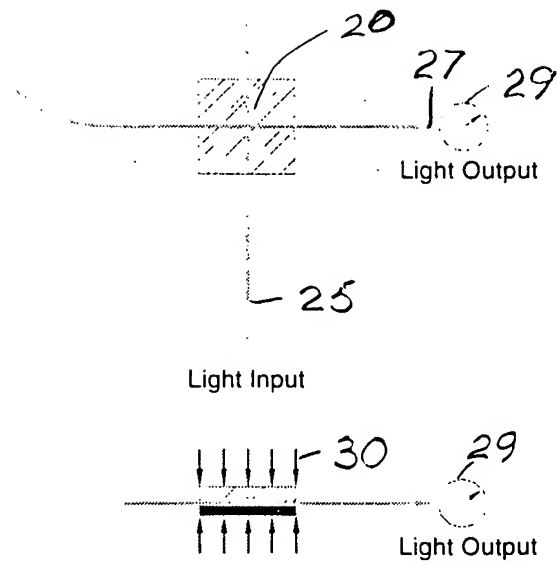


Fig. 2-5. Pinch Test

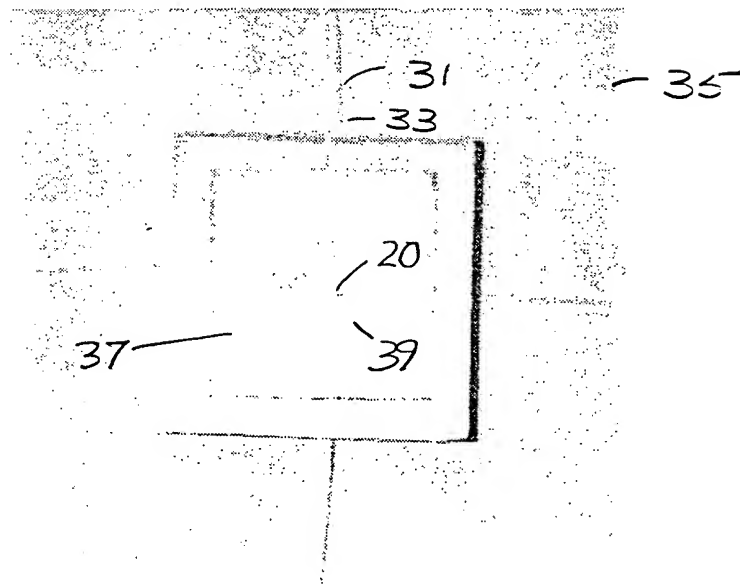


Fig. 2-6. Test Specimen

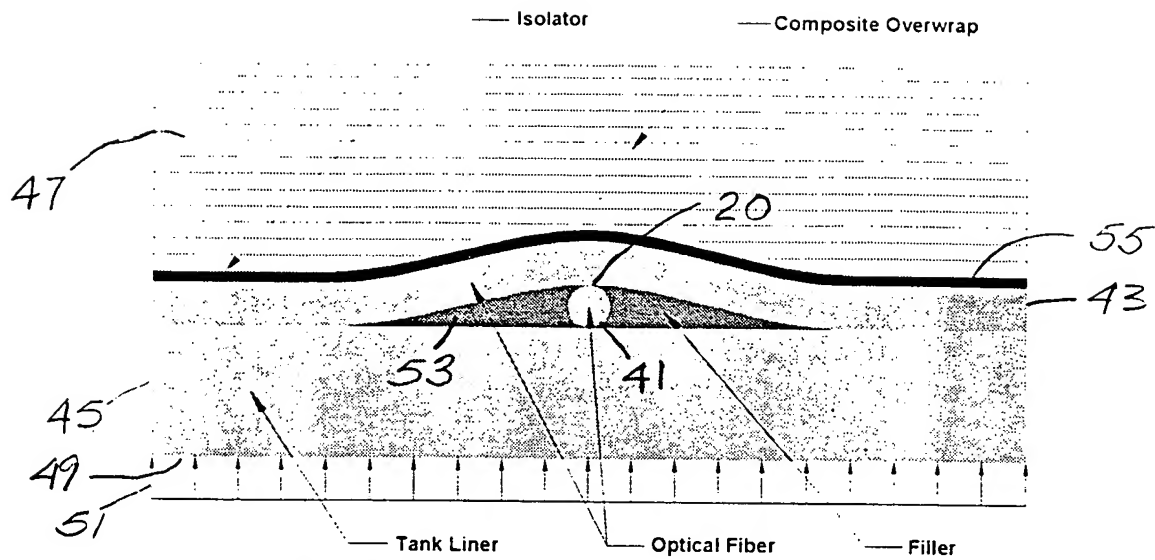


Fig. 2-7. Cross-section of Pinch Point

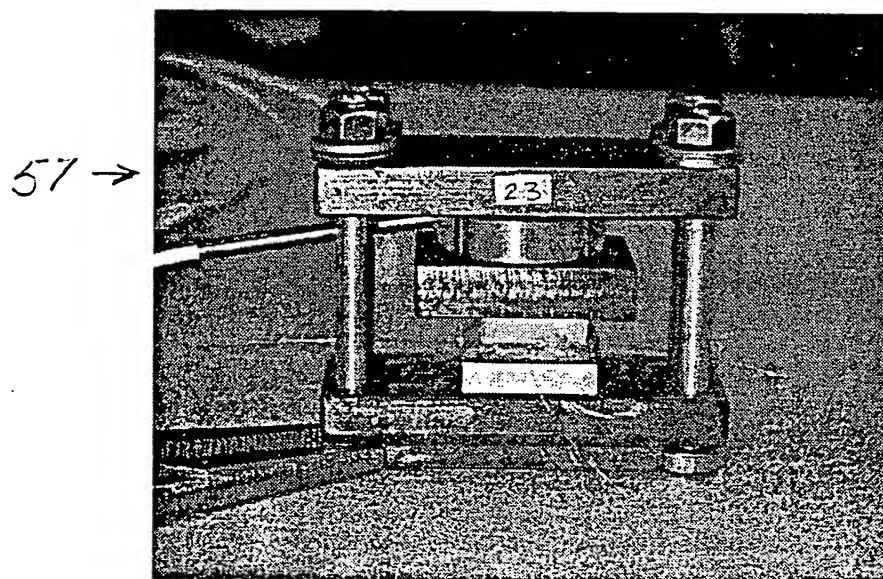


Fig. 2-8. Load Frame

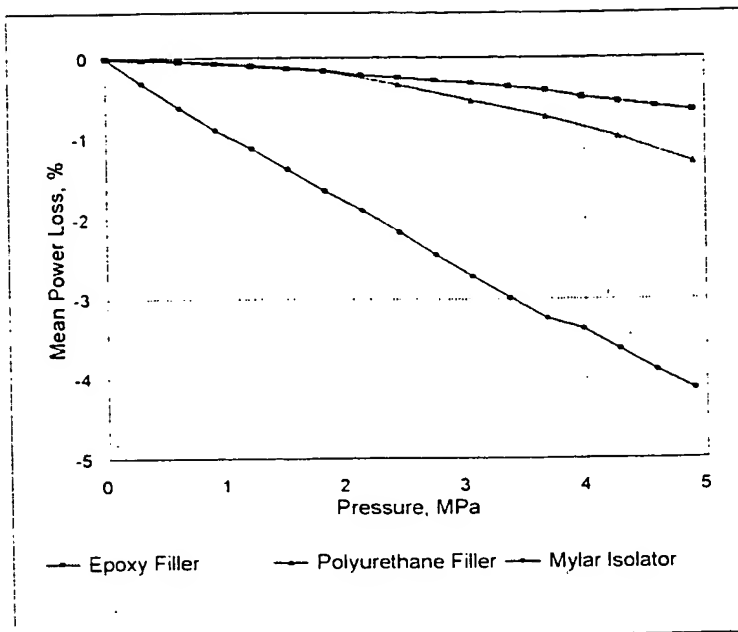


Fig. 2-9. Test Specimen Results

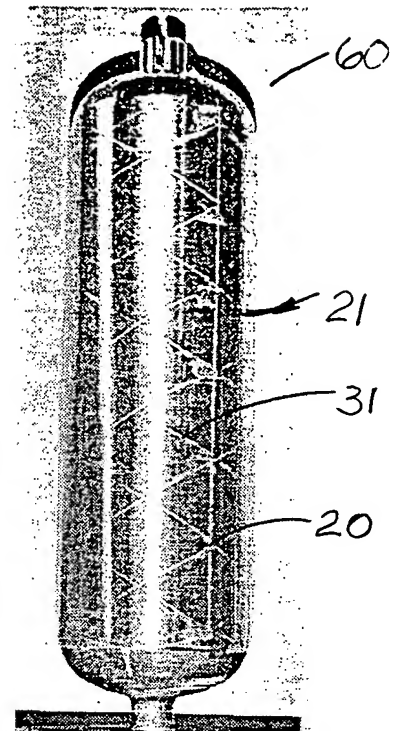


Fig. 2-10. Manually Wrapped Fiber Sensor

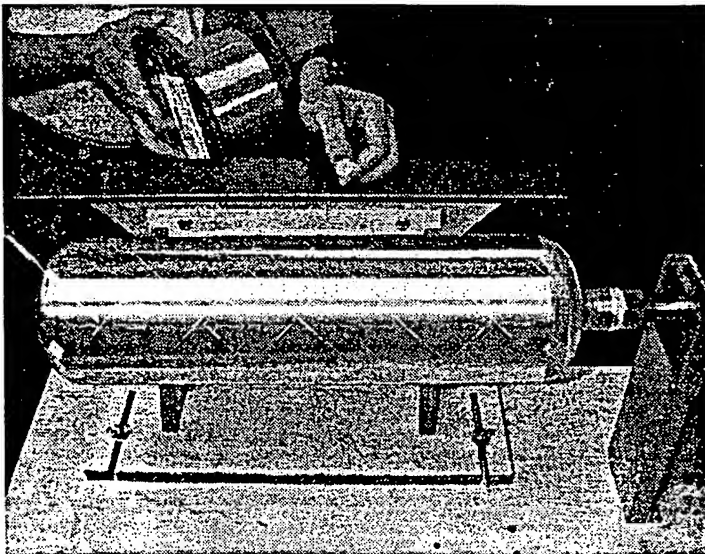


Fig. 2-11. Winding Dry Optical Fiber

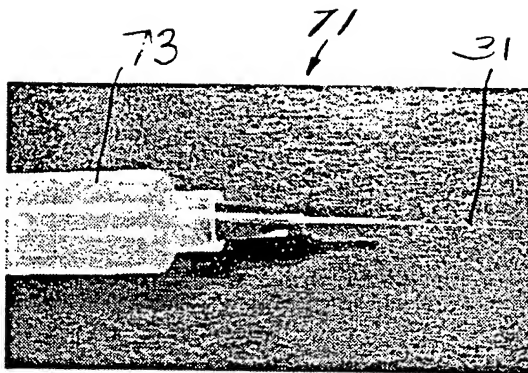


Fig. 2-12. Applicator Tip

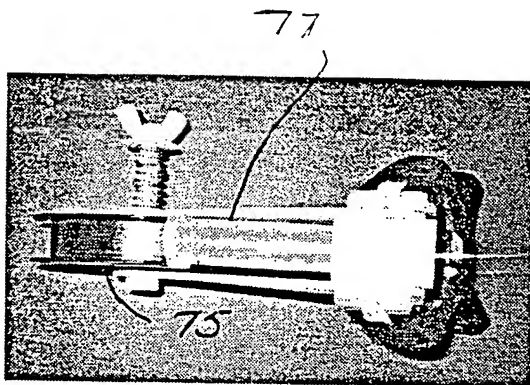


Fig. 2-13. Fiber Applicator

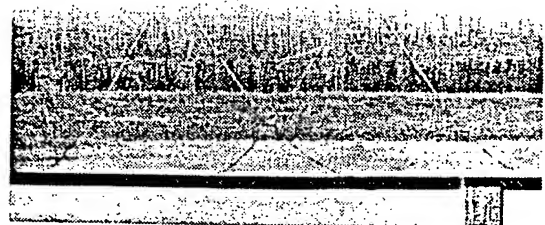
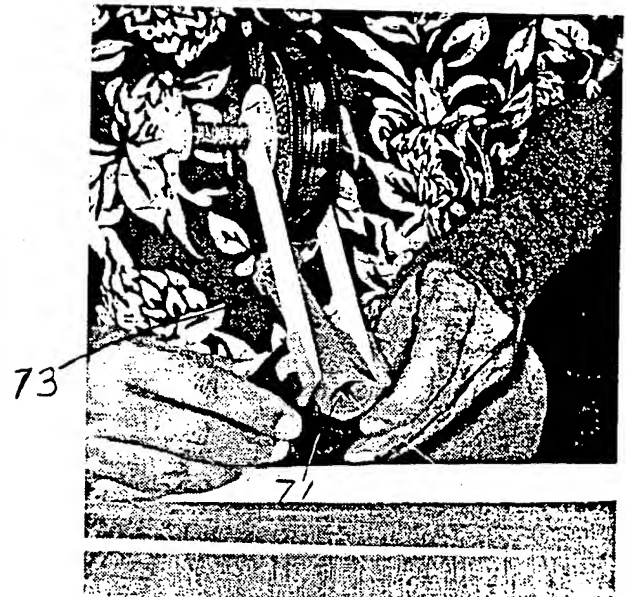


Fig. 2-14. Applying Filler-Coated Fiber



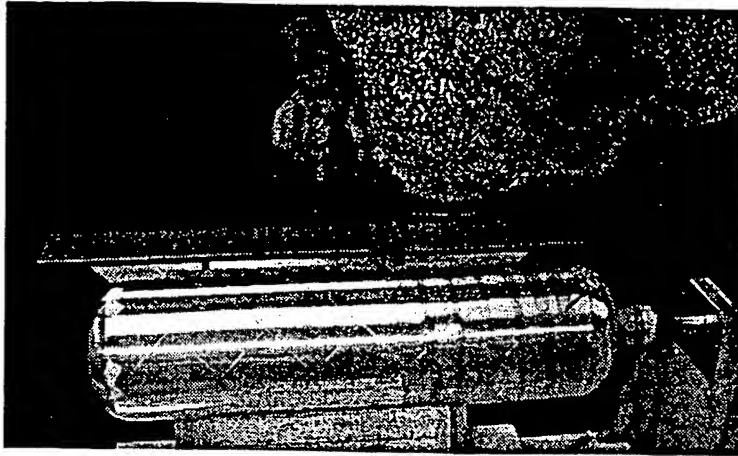


Fig. 2-15. Winding Shrink Tape

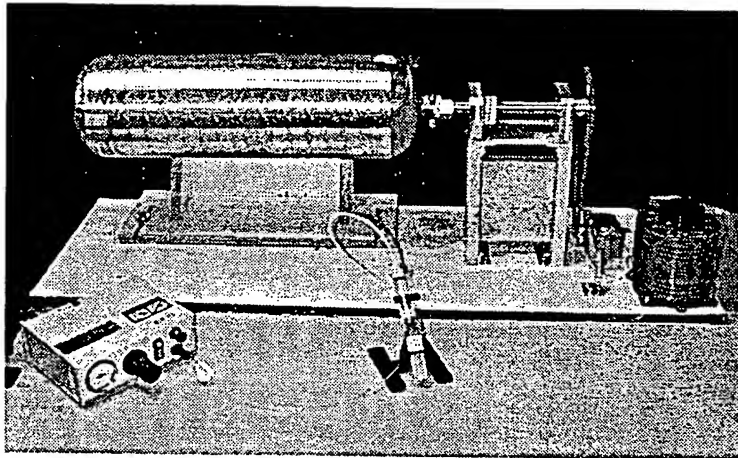


Fig. 2-16. Fiber/Tape Winding Machine

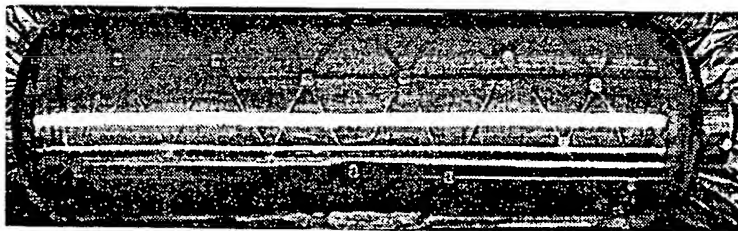


Fig. 2-17. Sensor System with Mylar Isolators



Fig. 2-18. Sensor System with Filler

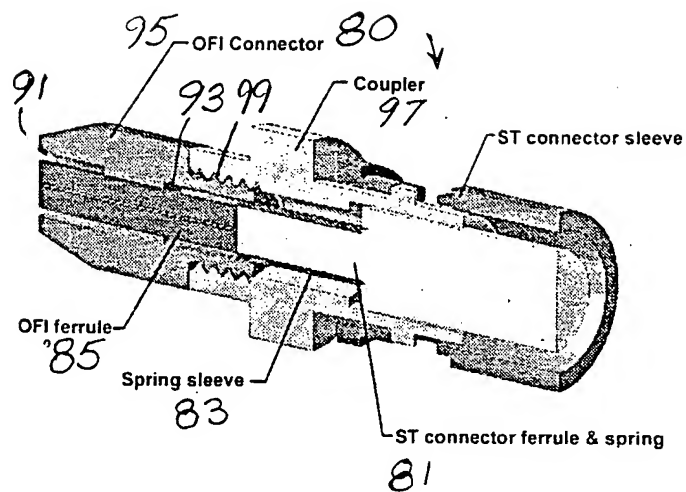


Fig. 3-1. Section View of the OFI Connector Mated to an ST Connector

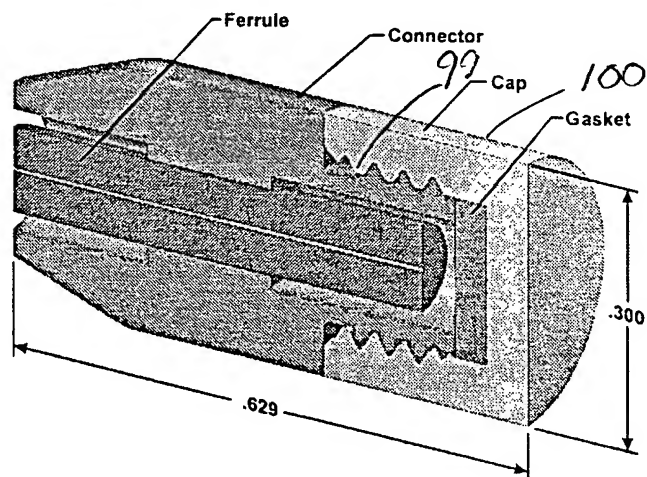
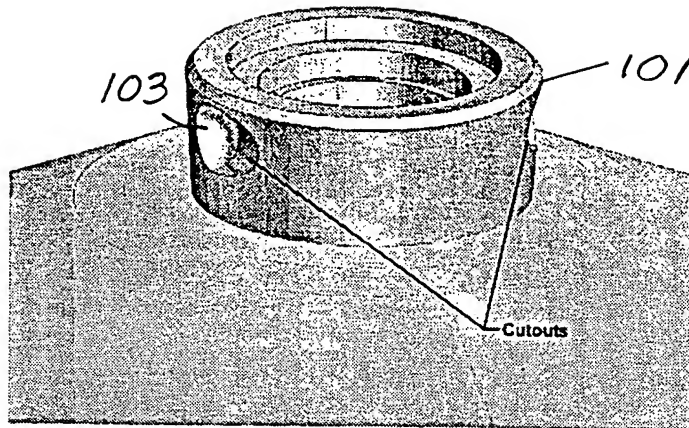
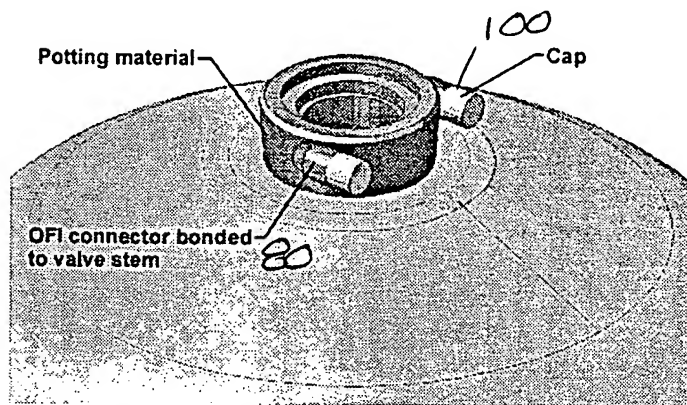


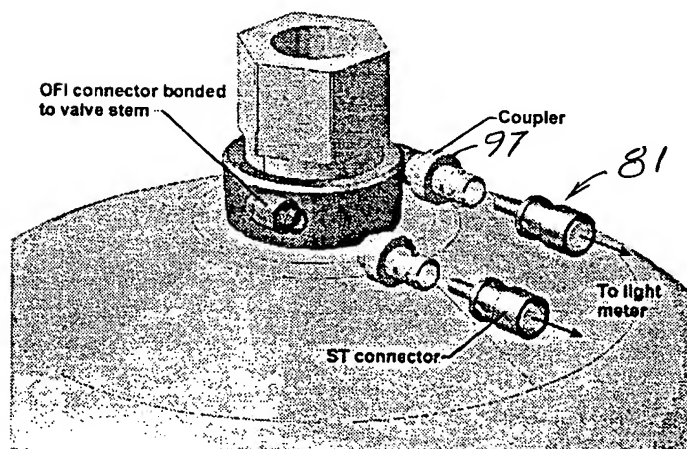
Fig. 3-2. Section View of Capped Connector



**Fig. 3-3. Mounting Cutouts in Valve Stem**



**Fig. 3-4. OFI Connector Mounting**



**Fig. 3-5. Attaching ST Connectors**

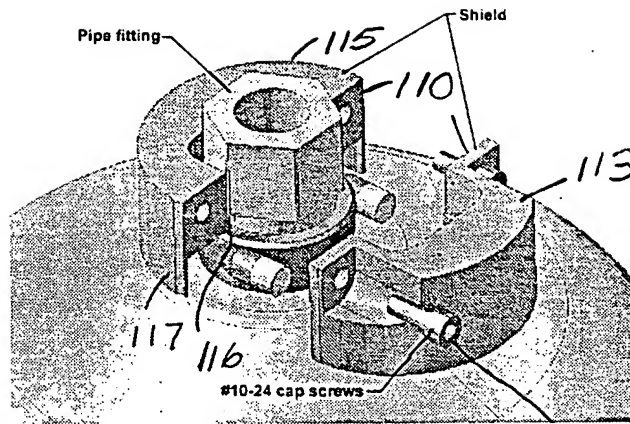


Fig. 3-6. Shield Components 111

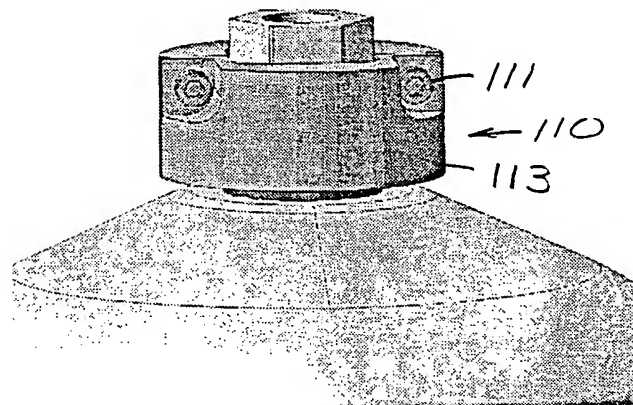


Fig. 3-7. Assembled Shield

954

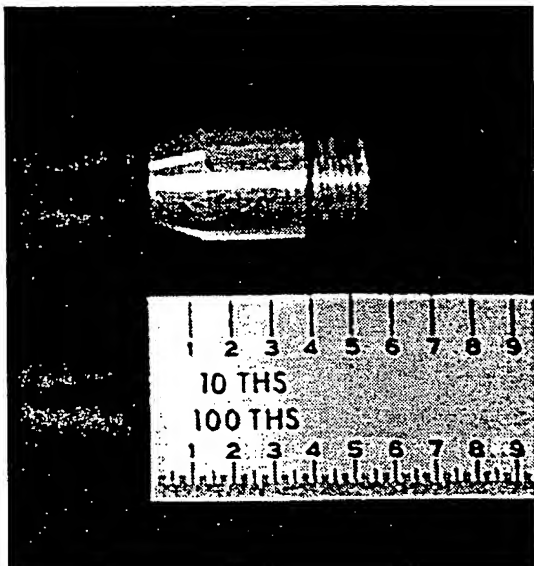


Fig. 3-8. Connector Housing

121

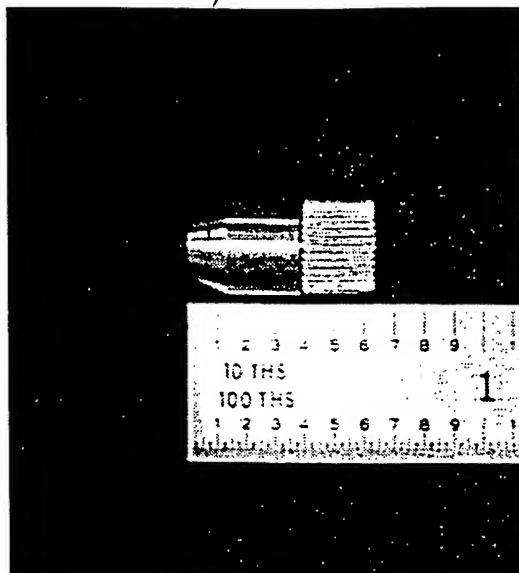


Fig. 3-9. Capped Housing

122



Fig. 3-10. Groove in Valve Stem

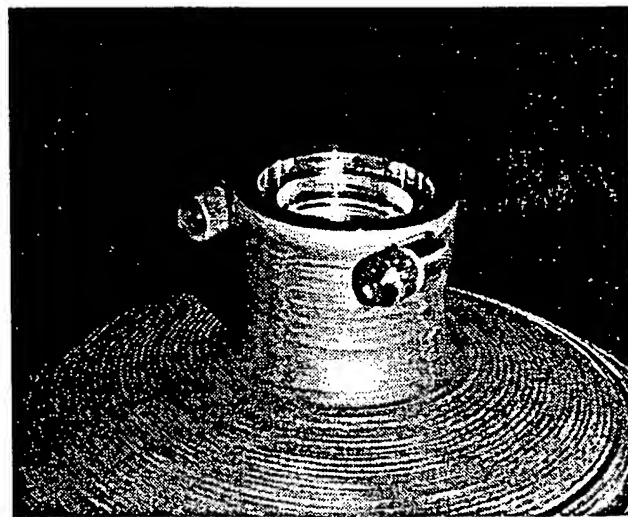


Fig. 3-11. Mounted Housings

124-

125-

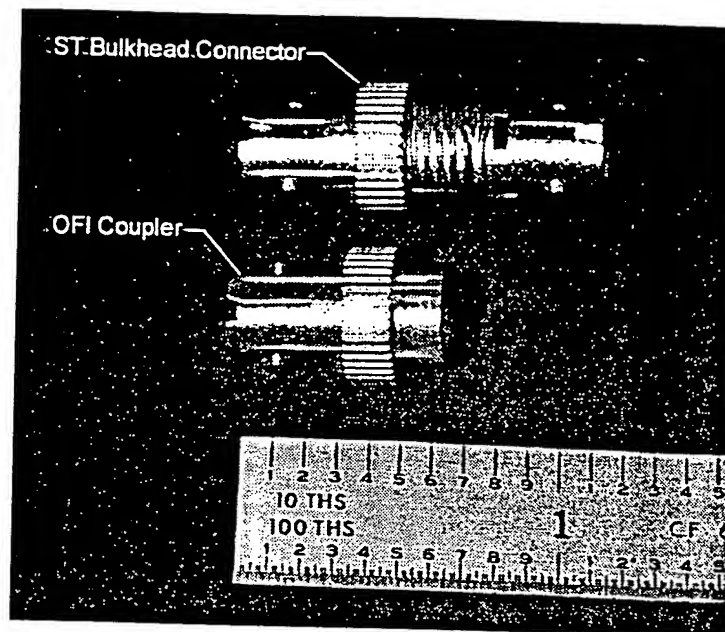
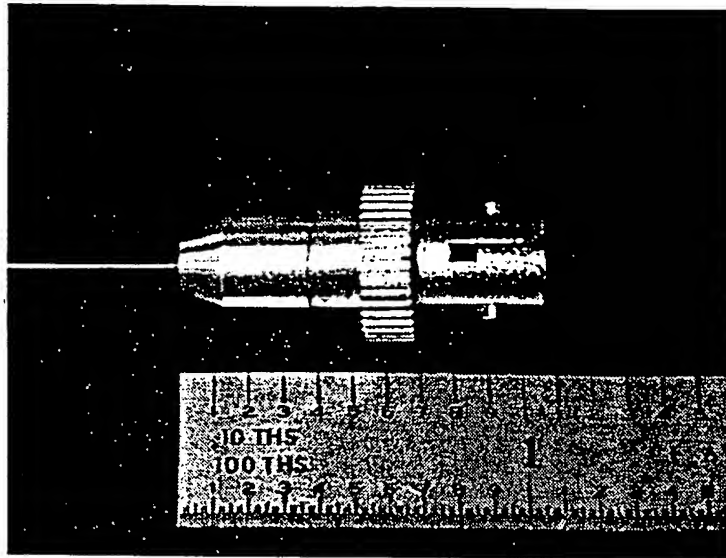


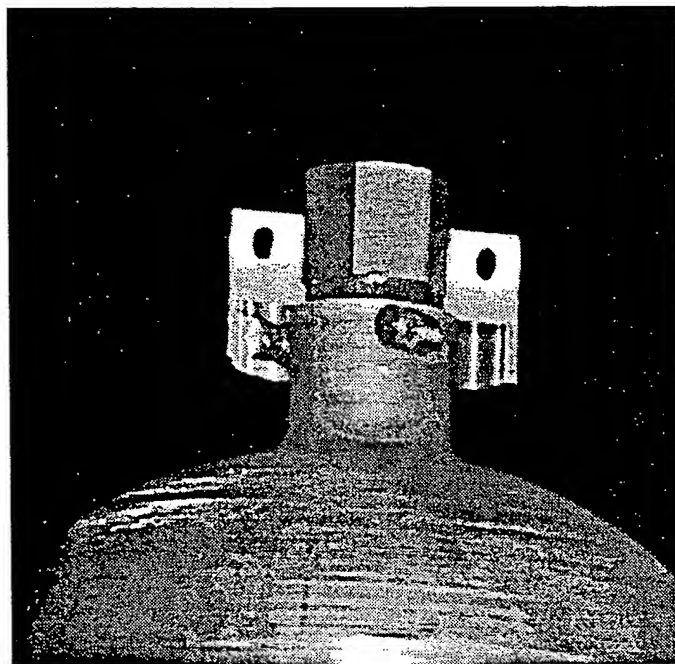
Fig. 3-12. OFI Coupler Modified from a Standard ST Bulkhead Connector



Fig. 3-13. Optical cable connected to OFI Connector



**Fig. 3-14. Coupler Mated to Connector Housing**



**Fig. 3-15. Section View of Connector Shield**

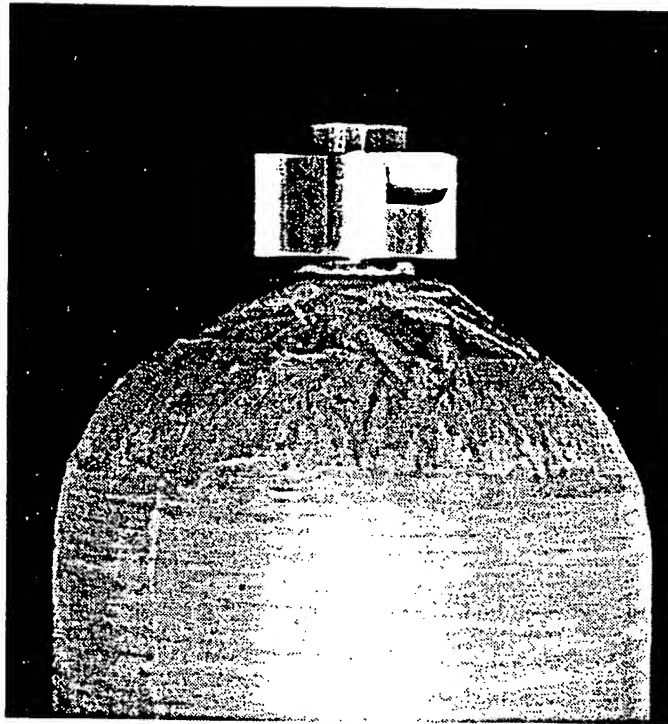


Fig. 3-16. Assembled Connector Shield

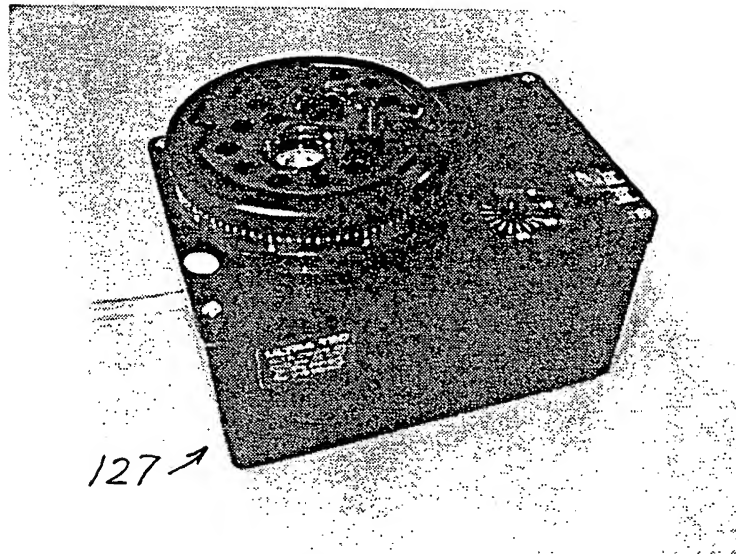
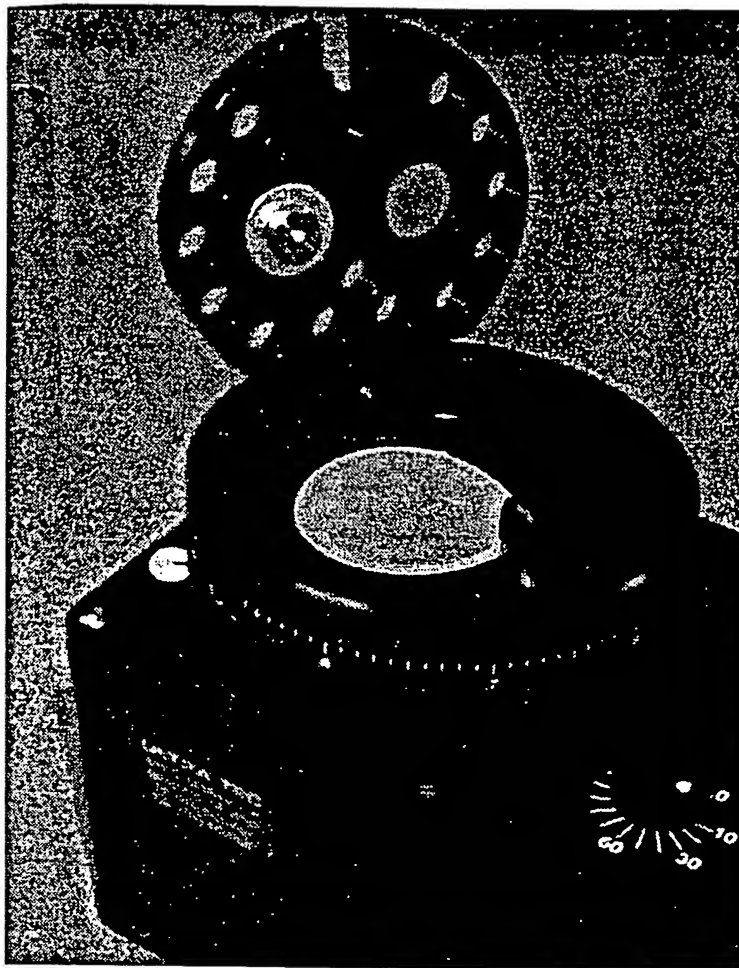
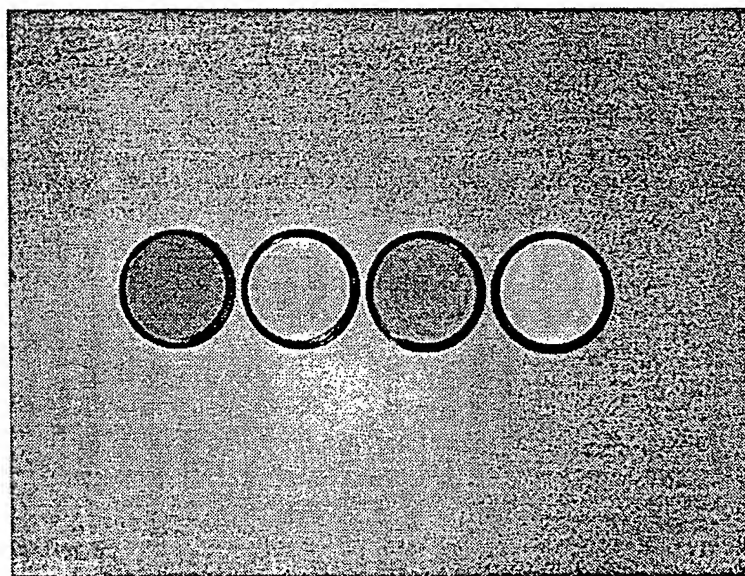


Fig. 3-17. Fiber Polishing Machine

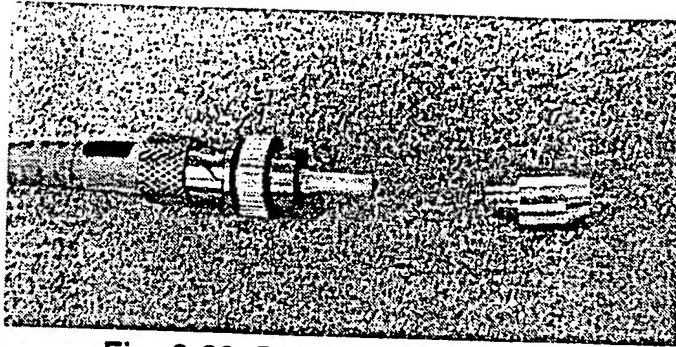




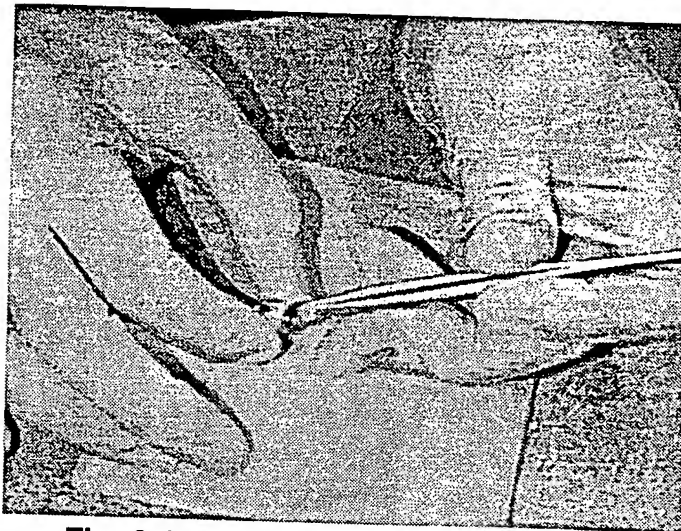
**Fig. 3-18. Ferrule Inserted in Lid**



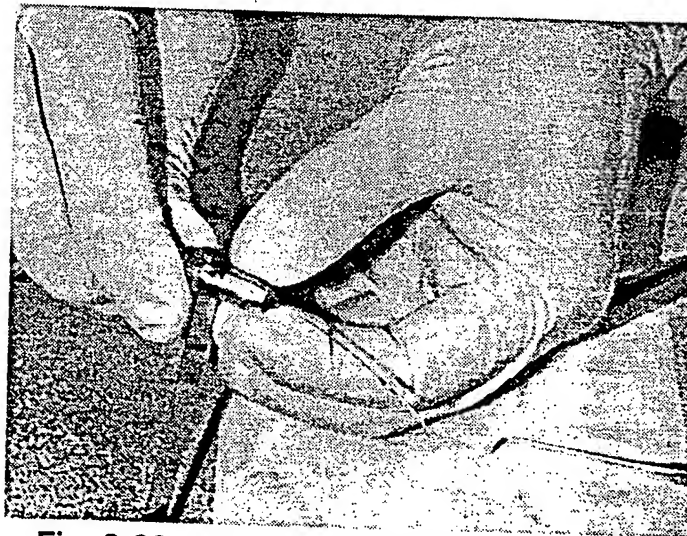
**Fig. 3-19. Abrasives**



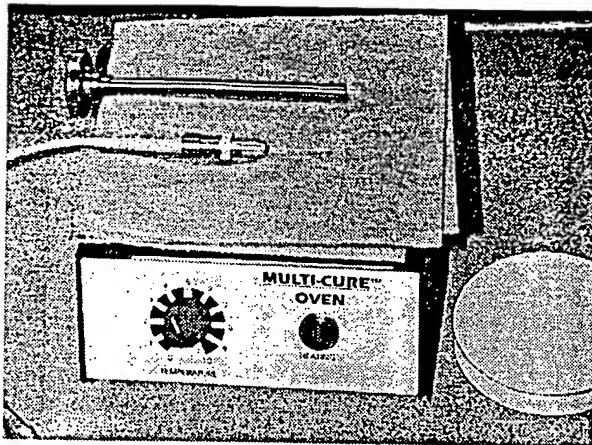
**Fig. 3-20. Ferrule and Housing**



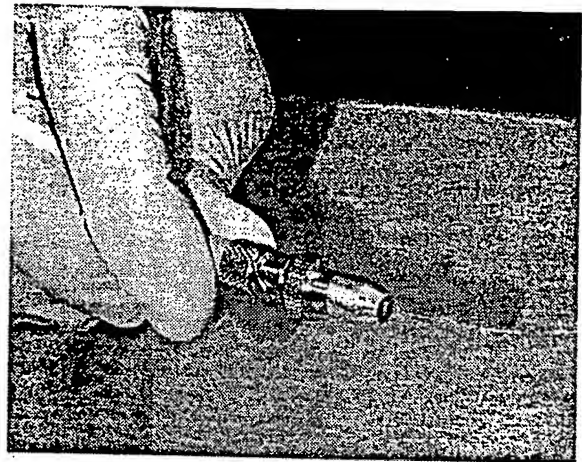
**Fig. 3-21. Applying Epoxy Adhesive**



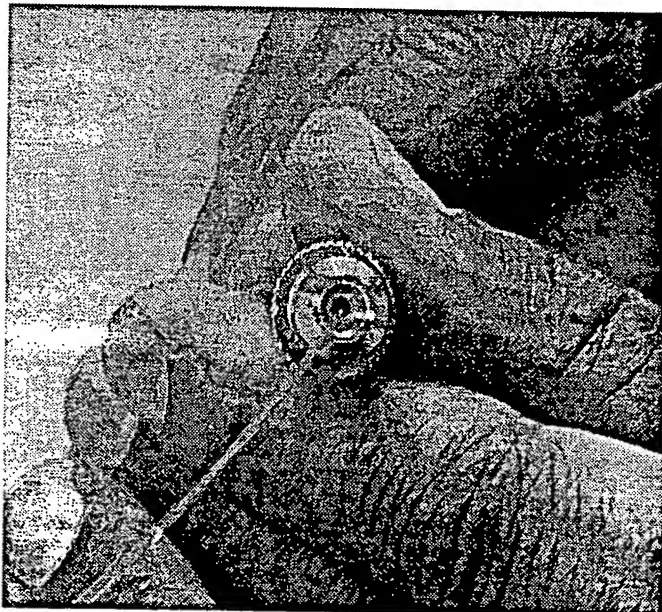
**Fig. 3-22. Attaching Housing to Coupler**



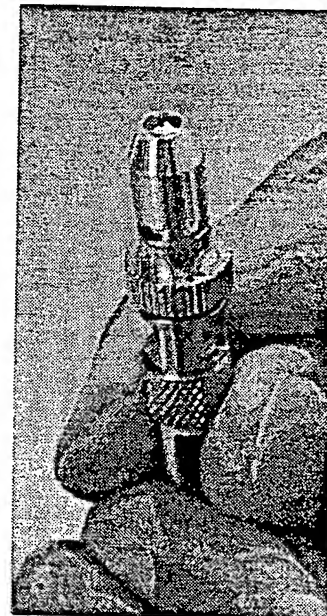
**Fig. 3-23. Thermal Cure of Assembly**



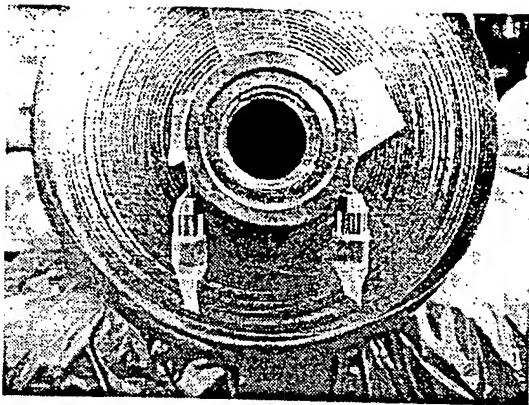
**Fig. 3-24. Completed Assembly**



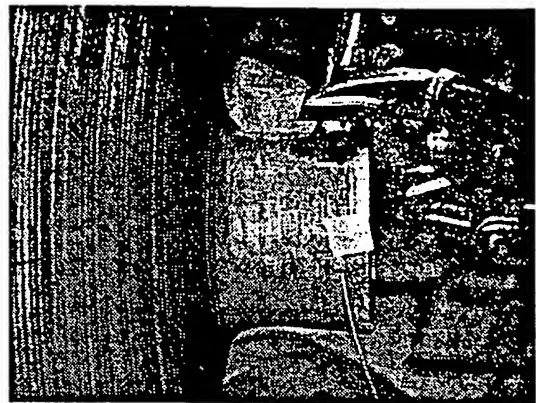
**Fig. 3-25. Ferrule Positioned in Housing**



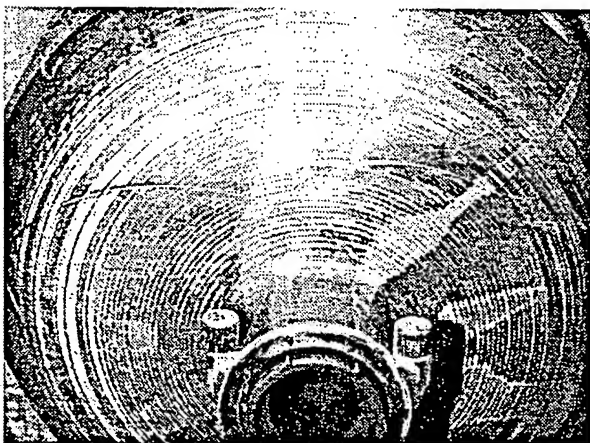
**Fig. 3-26. Ferrule Bonded in Housing**



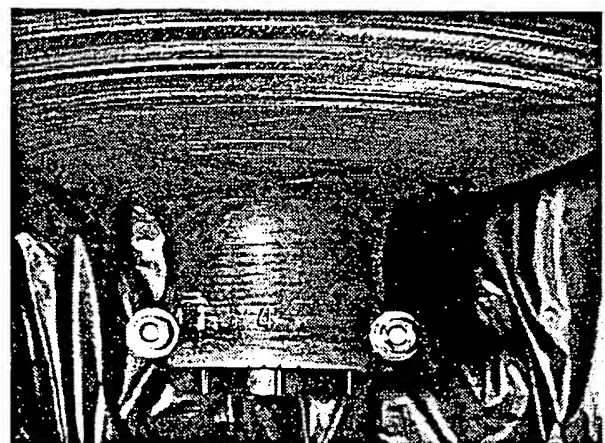
**Fig. 3-27. Connectors Ready for Bonding to Tank Liner**



**Fig. 3-28. Connector Bonded to Tank**



**Fig. 3-29. End Connectors**



**Fig. 3-30. Connectors Showing Optical Ferrules**

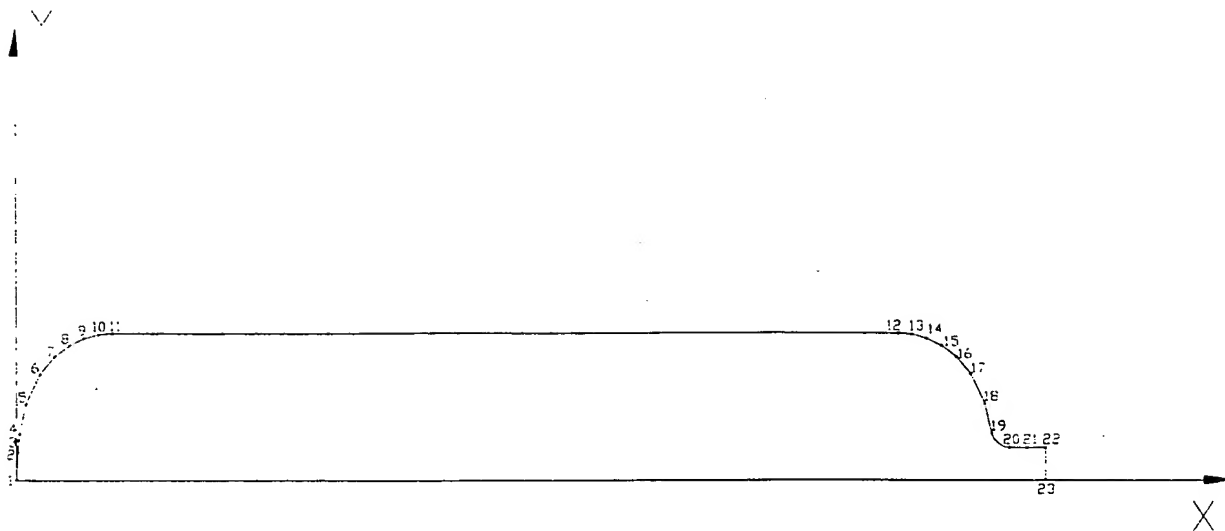


Fig. 4-1. Aluminum Liner Profile

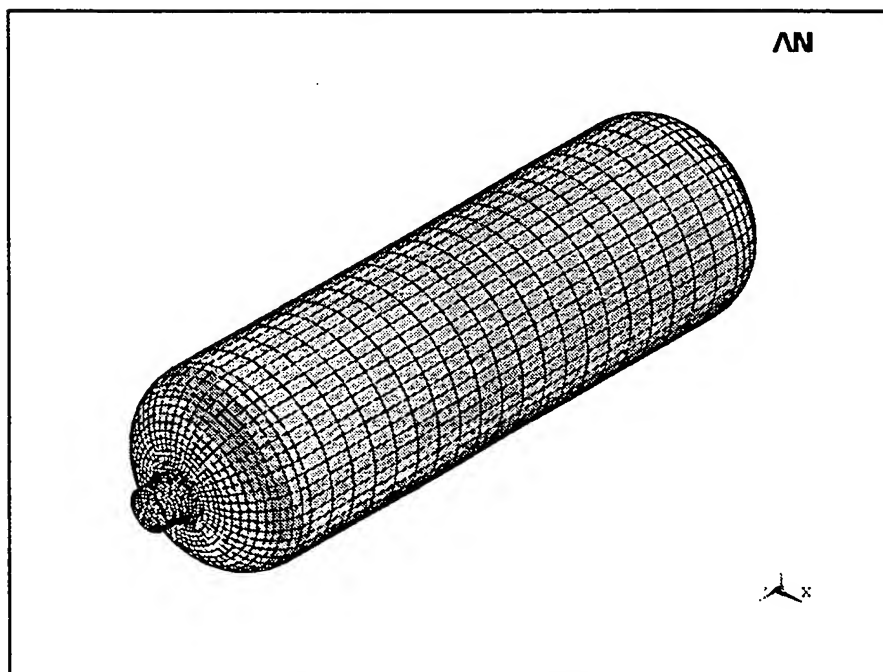


Fig. 4-2. Finite Element Model

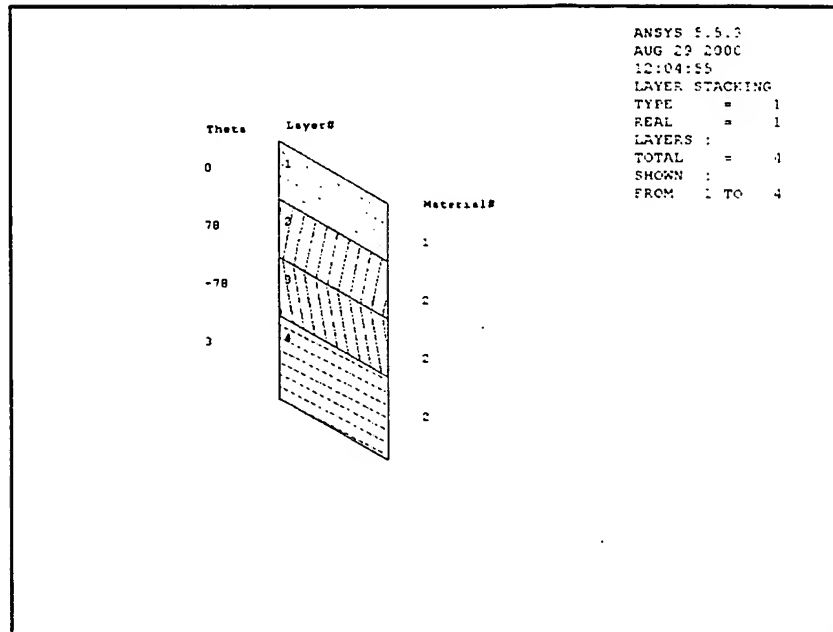


Fig. 4-3. Stacking Sequence on Cylindrical Section

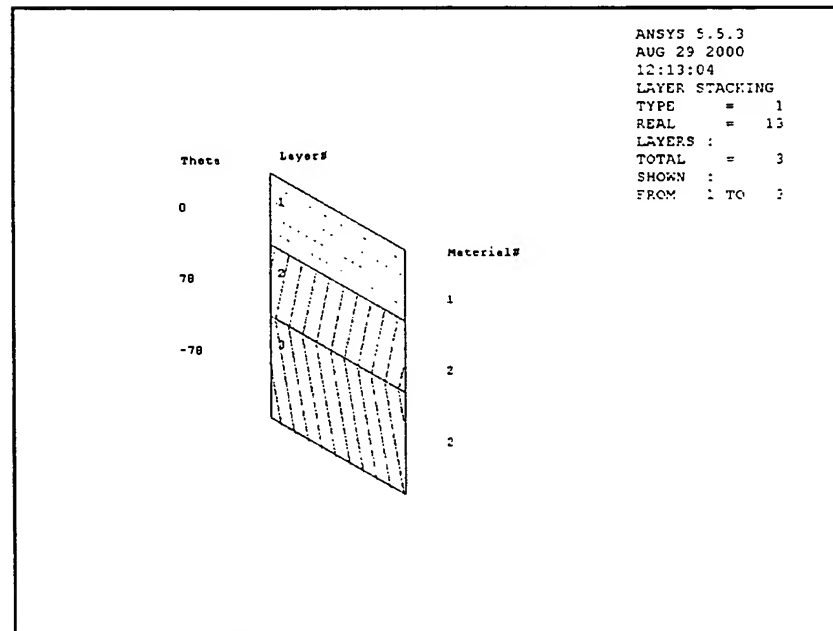


Fig. 4-4. Stacking Sequence at End Sections



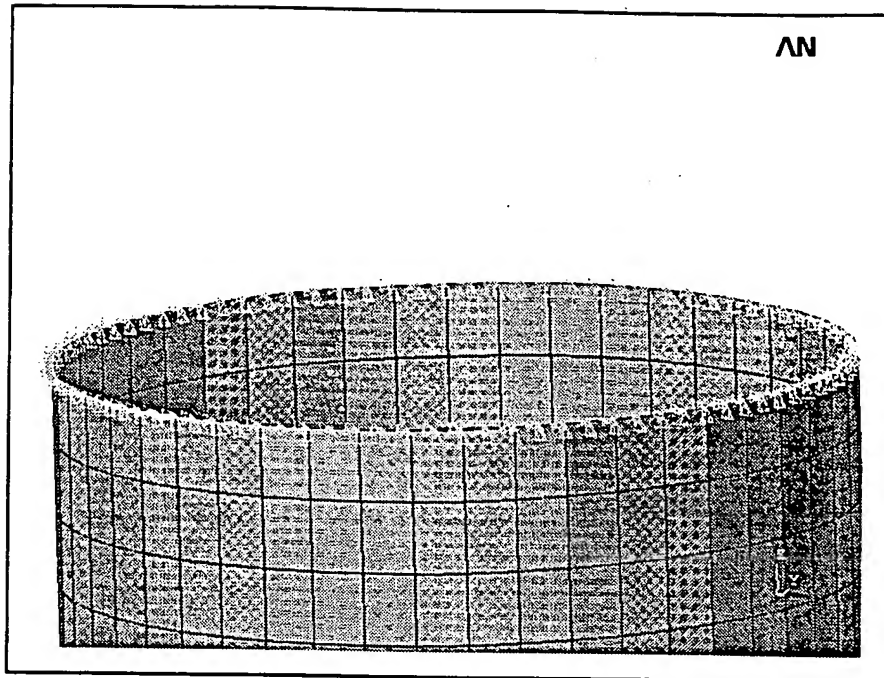


Fig. 4-5. Translational Restraints at Tank Neck

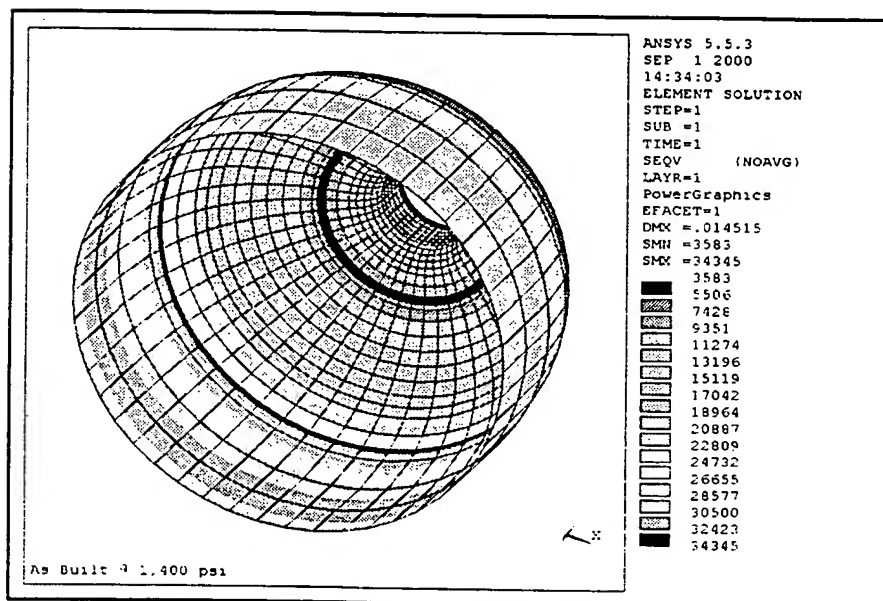


Fig. 4-6. von Mises Stress on Aluminum Liner at 1,400 psi

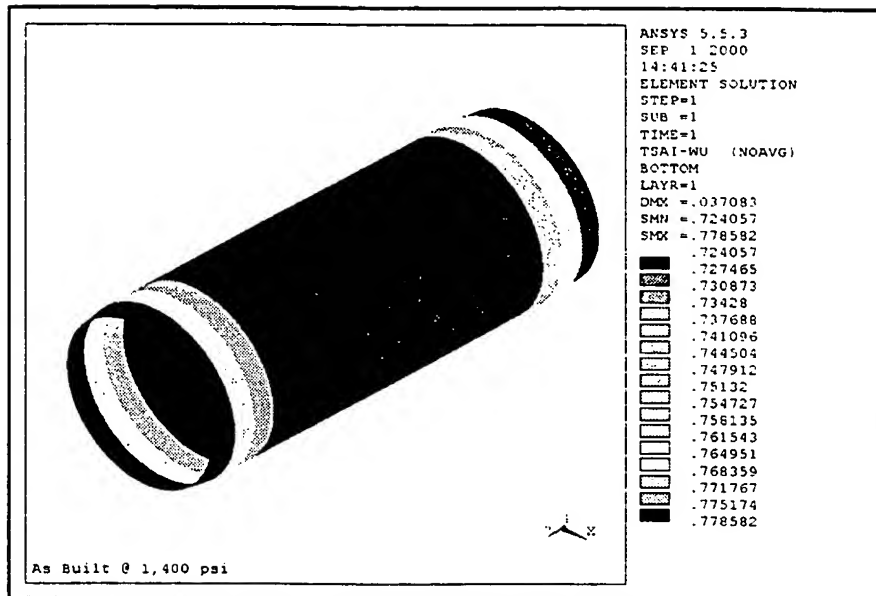


Fig. 4-7. Tsai-Wu Inverse Strength Ratio at 1,400 psi

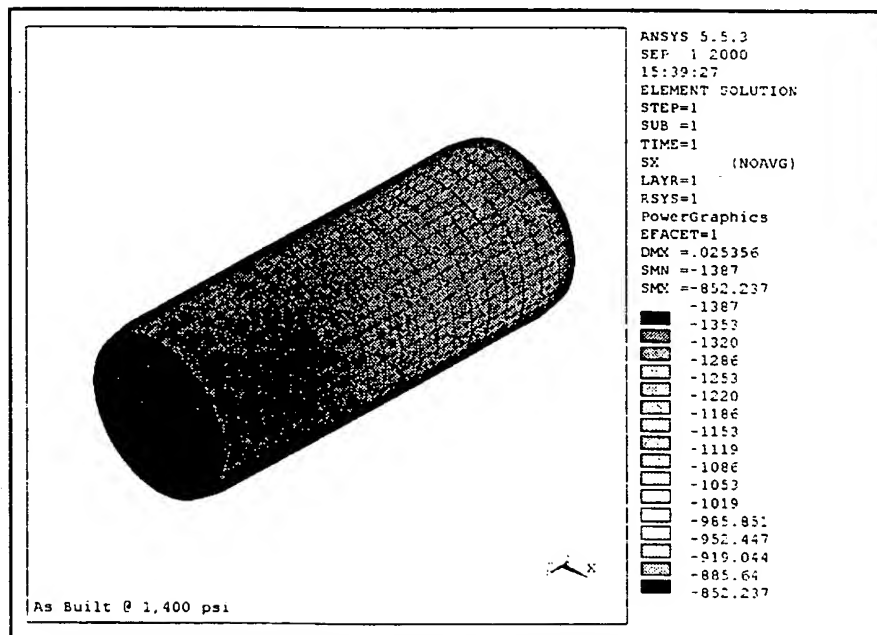


Fig. 4-8. Radial Pressure on Fiber Sensor is 850 psi



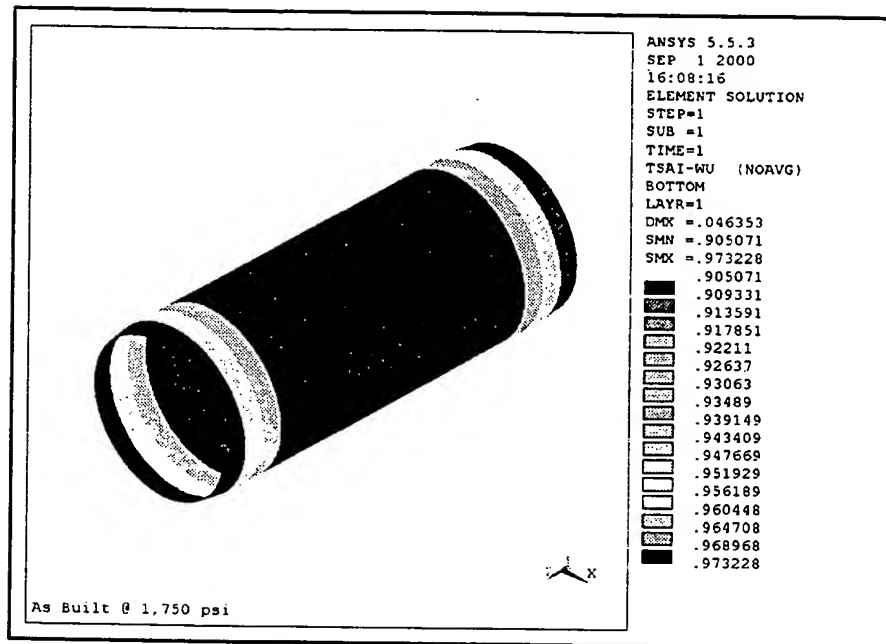


Fig. 4-9. Tsai-Wu Inverse Strength Ratio at 1,750 psi

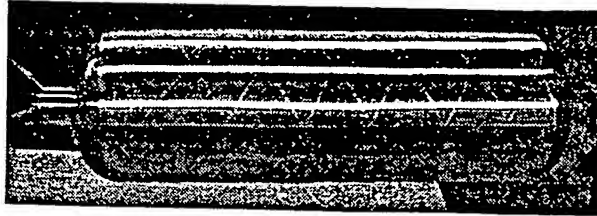


Fig. 4-10. Tank 1 Sensor



Fig. 4-11. Tank 2 Sensor



Fig. 4-12. Tank 3 Sensor

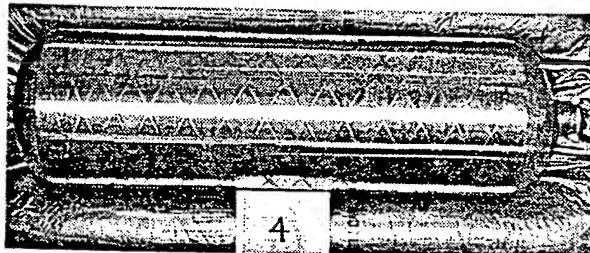


Fig. 4-13. Tank 4 Sensor

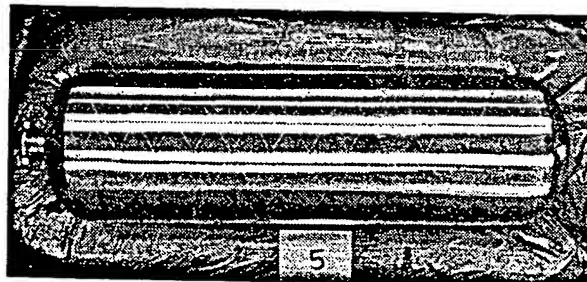
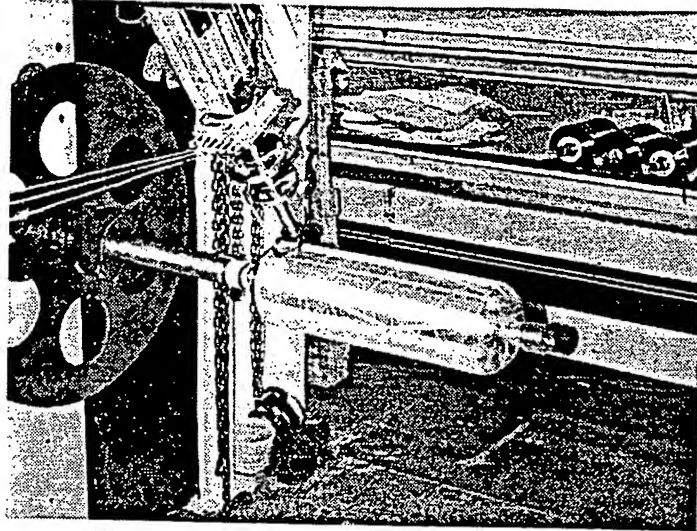


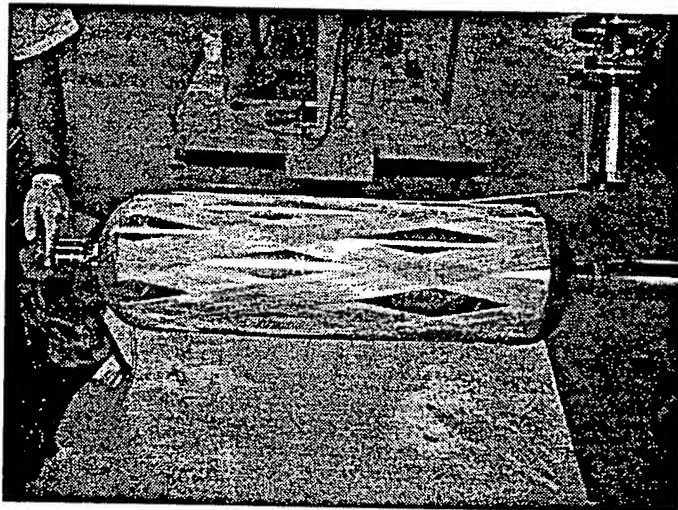
Fig. 4-14. Tank 5 Sensor



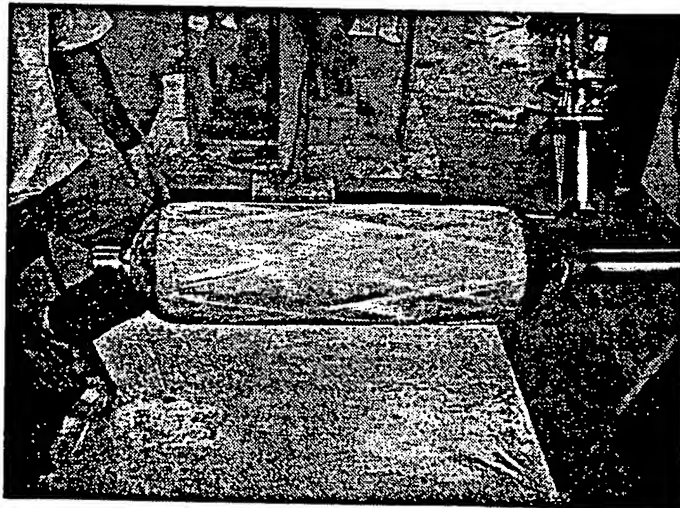
Fig. 4-15. Tank 6 Sensor



**Fig. 4-16. Setup Winding Machine**



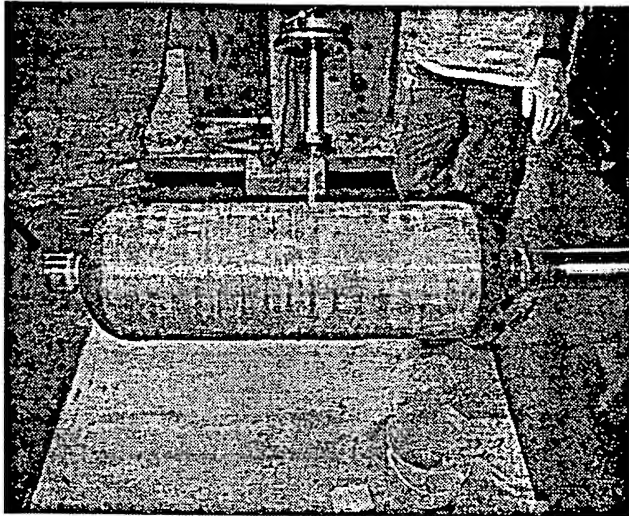
**Fig. 4-17. Progression of Axial Winds**



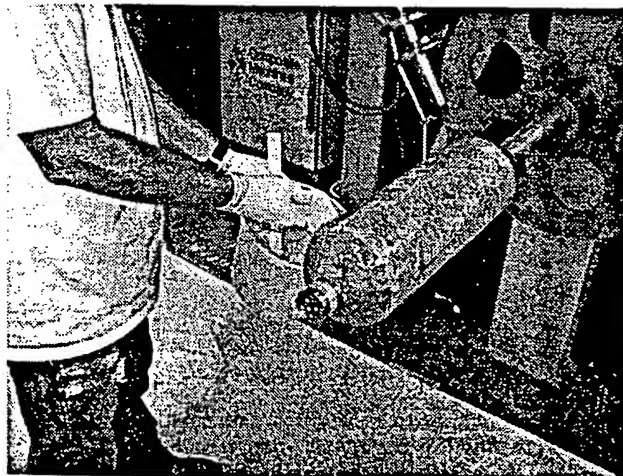
**Fig. 4-18. Completion of Axial Wind**



**Fig. 4-19. Start of 87° Hoop Wind**



**Fig. 4-20. Progression of Hoop Wind**



**Fig. 4-21. Completed Hoop Wind**

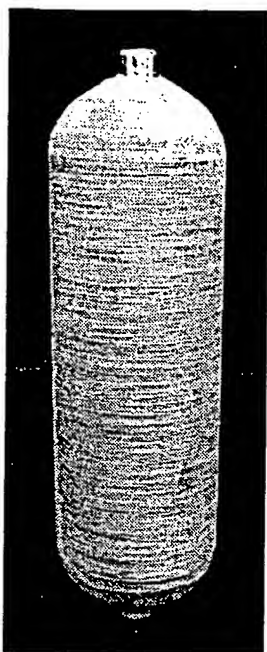


Fig. 4-22. Tank 1

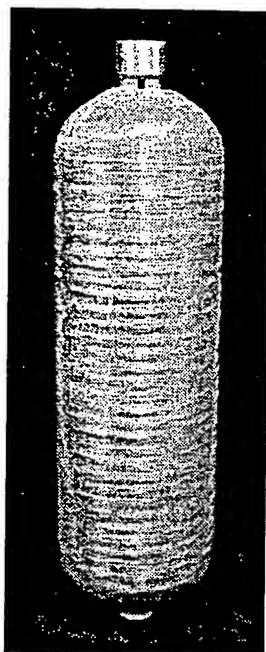


Fig. 4-23. Tank 2

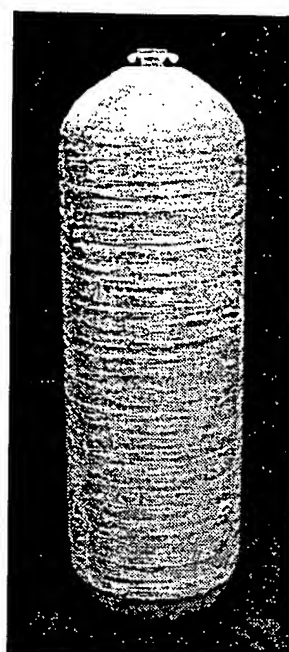


Fig. 4-24. Tank 3

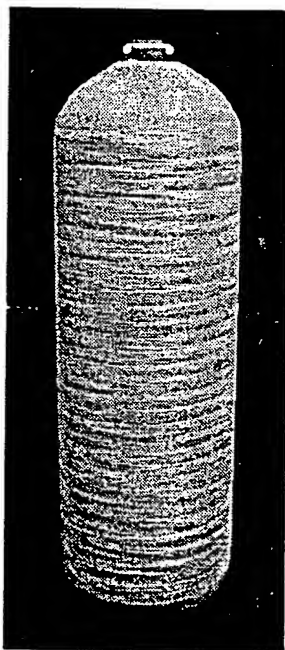


Fig. 4-25. Tank 4

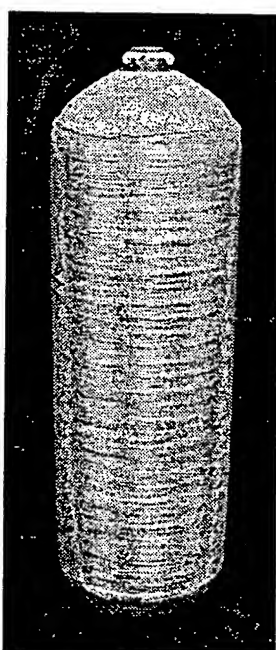


Fig. 4-26. Tank 5

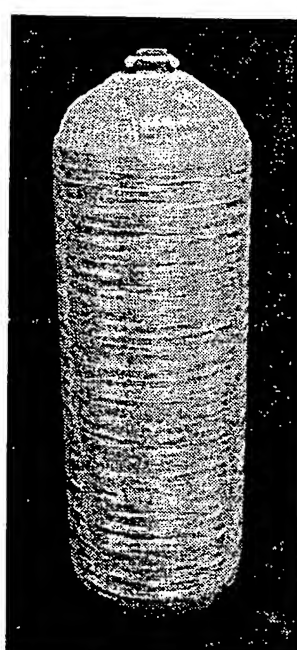
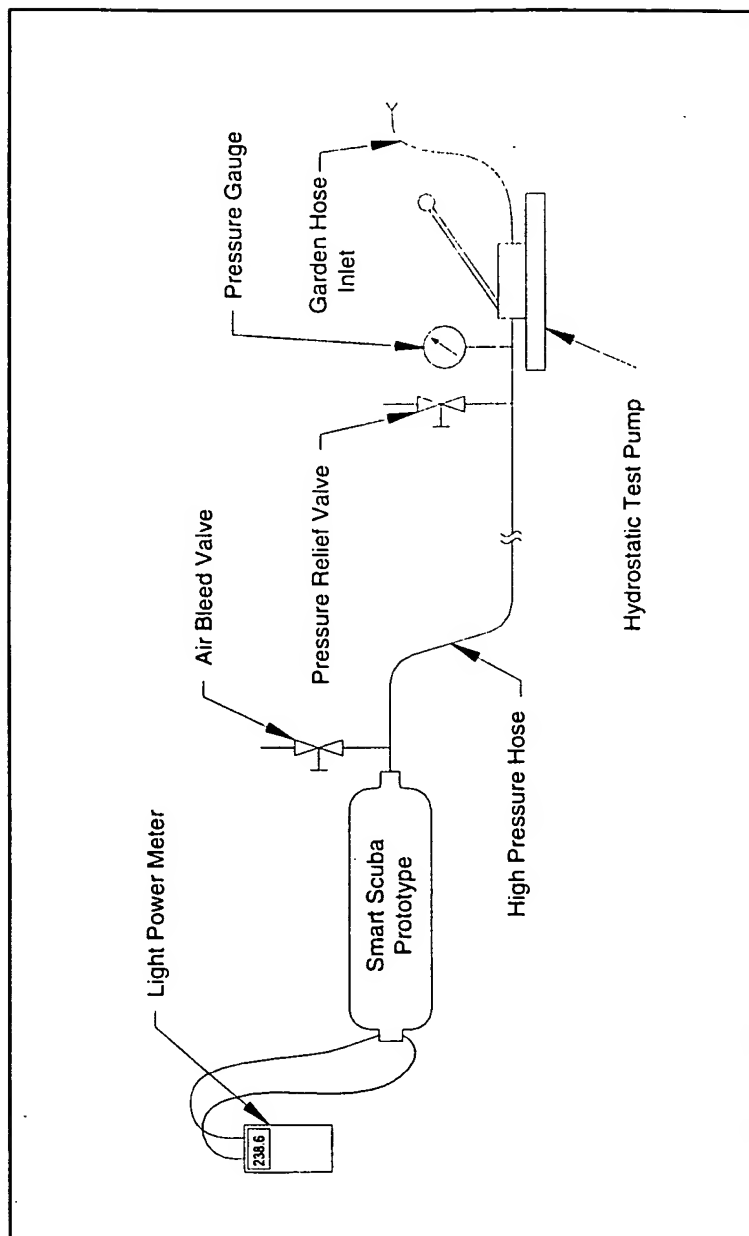


Fig. 4-27. Tank 6



**Fig. 5-1. Fiber Optic Pressure Test Setup**



Fig. 5-2. Test Tank 2 Setup

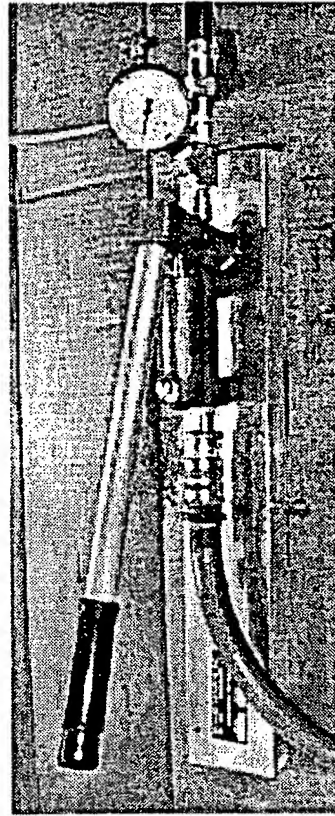
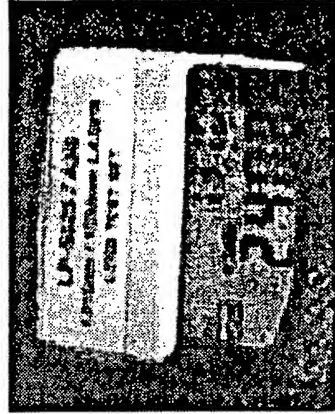


Fig. 5-3. Light Power 240.8  $\mu$ w at 0 psi





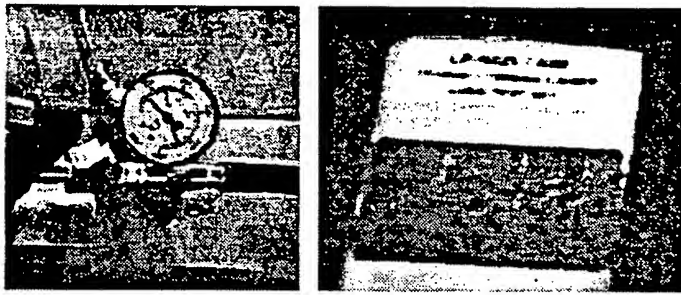


Fig. 5-4. Light Power 225.6  $\mu\text{w}$  at 700 psi

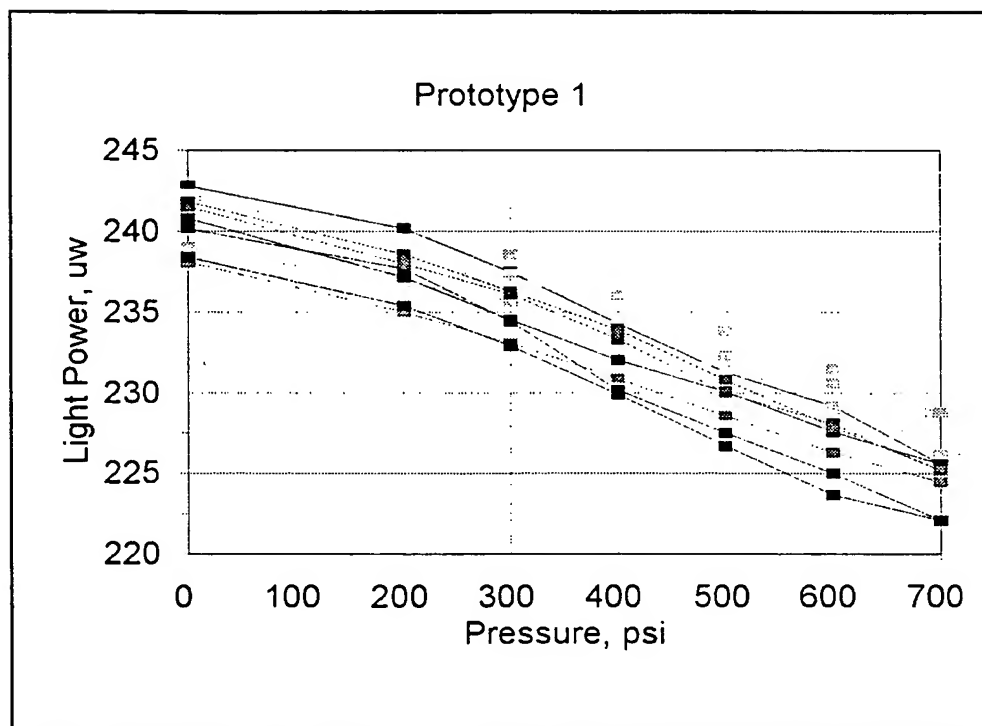


Fig. 5-5. Tank 2 Light Power Response for Six Pressure Cycles



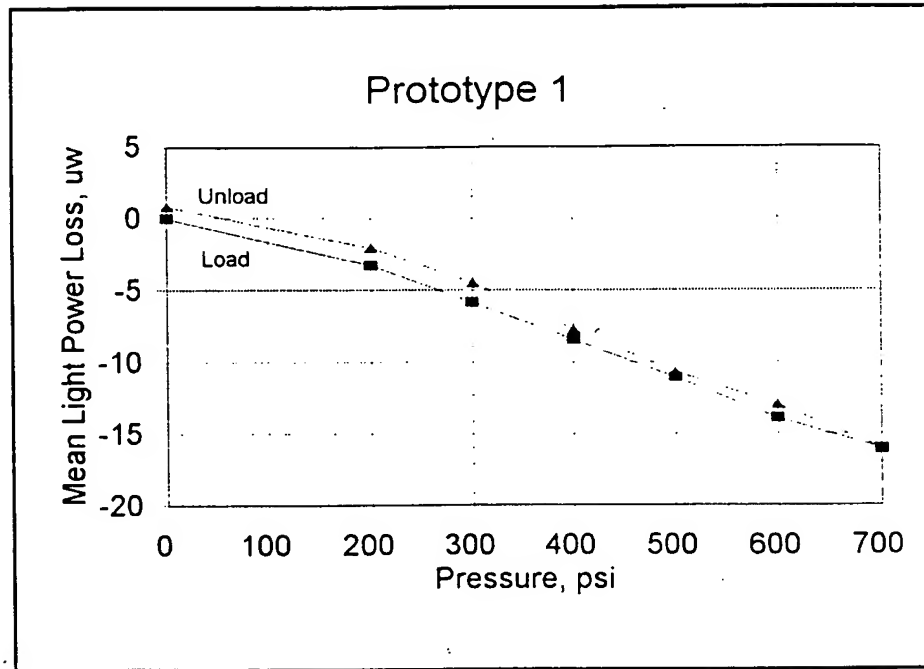
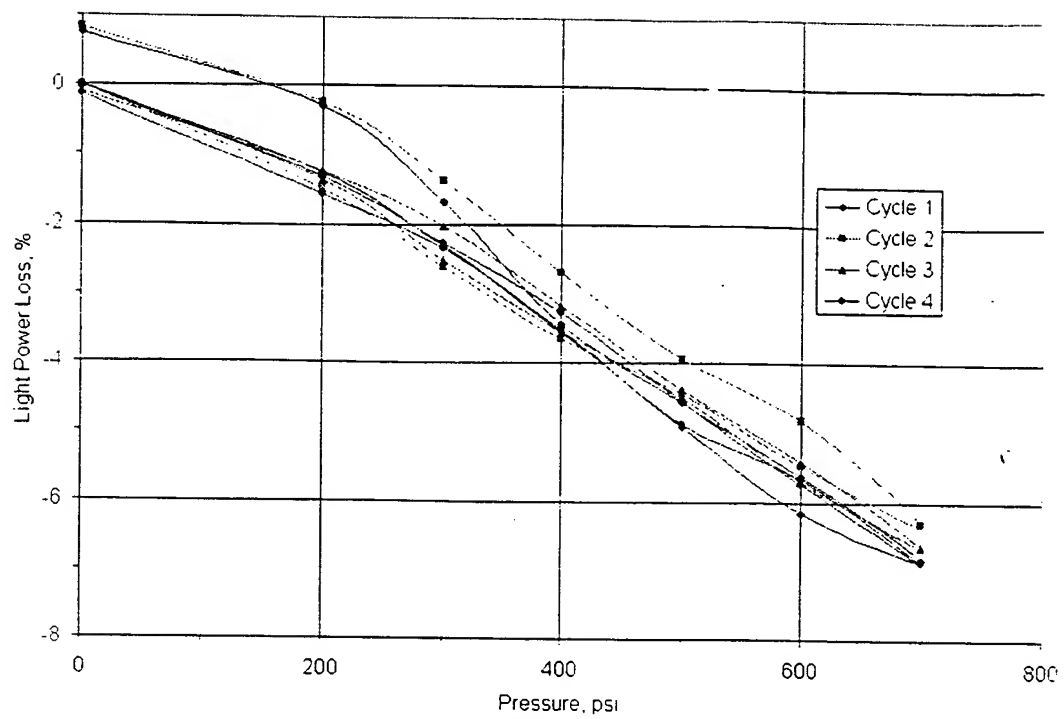
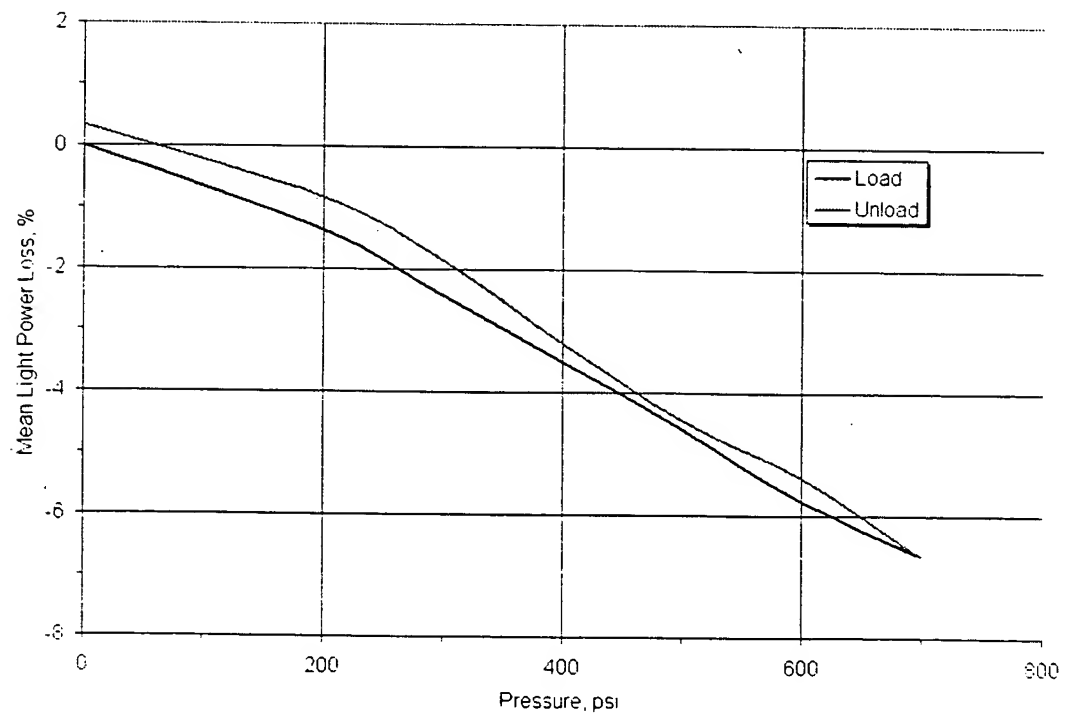


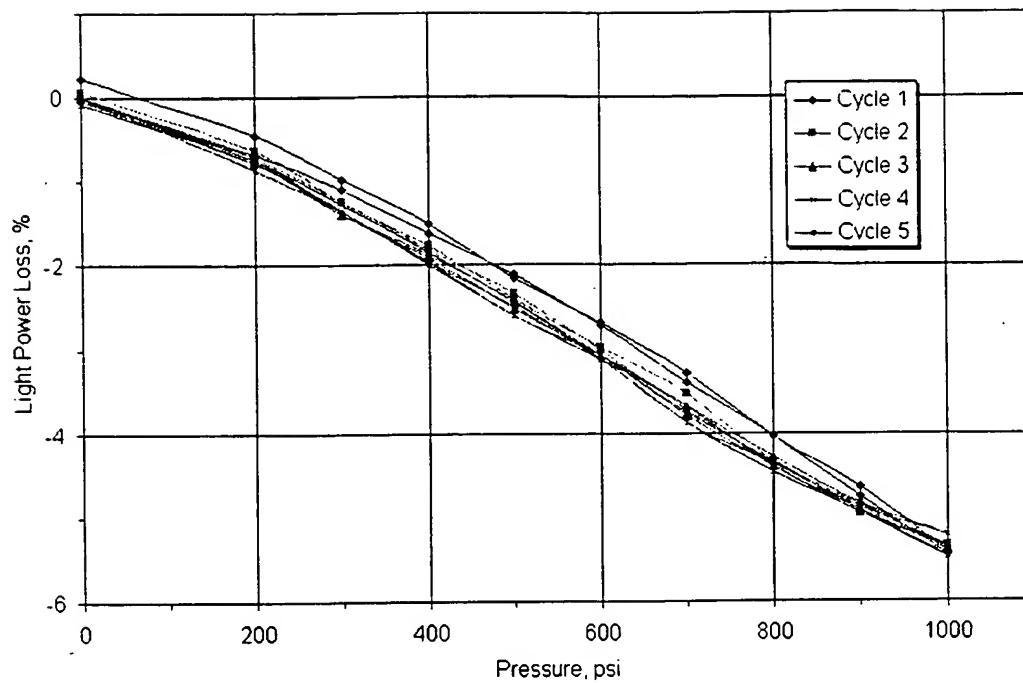
Fig. 5-6. Tank 2 Mean Light Power Loss for Cycles 3-6



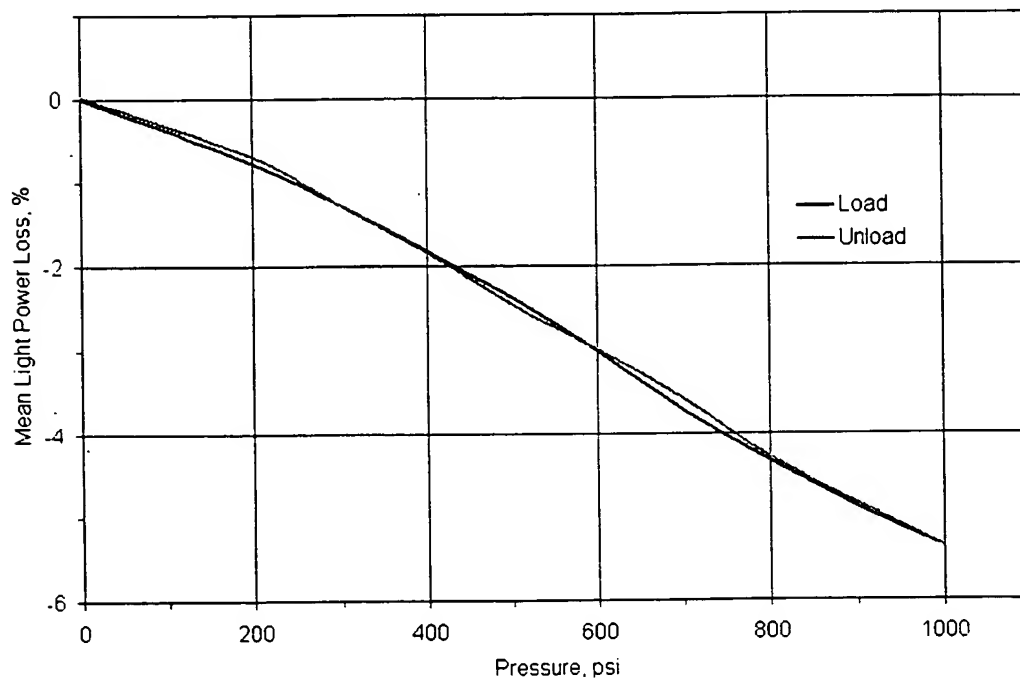
**Fig. 5-7. Tank 2 Light Power Loss**



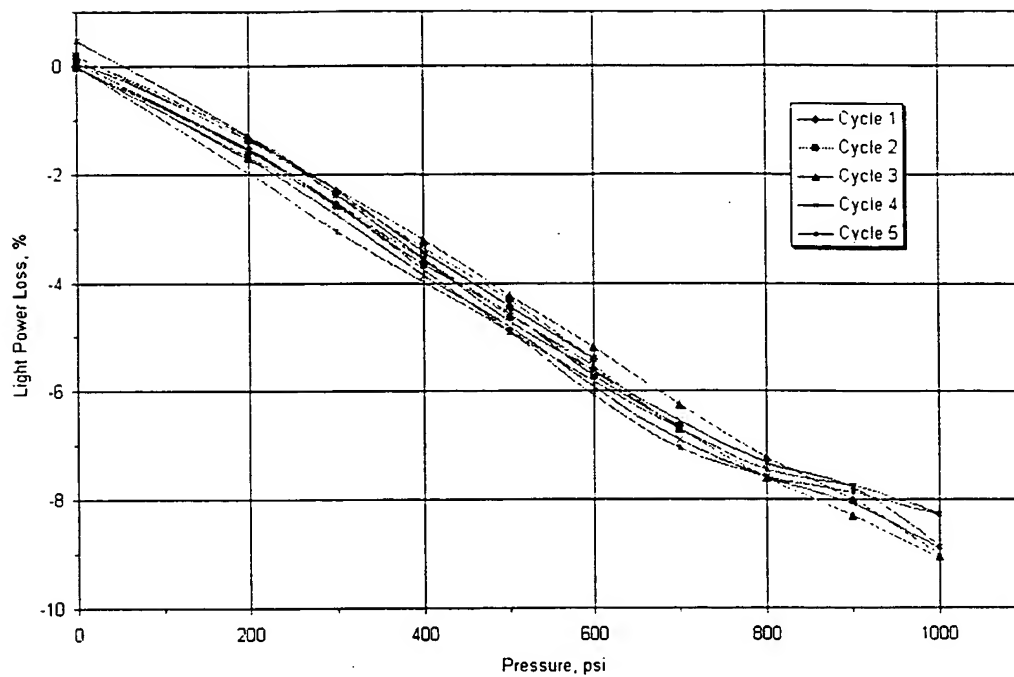
**Fig. 5-8. Tank 2 Mean Light Power Loss**



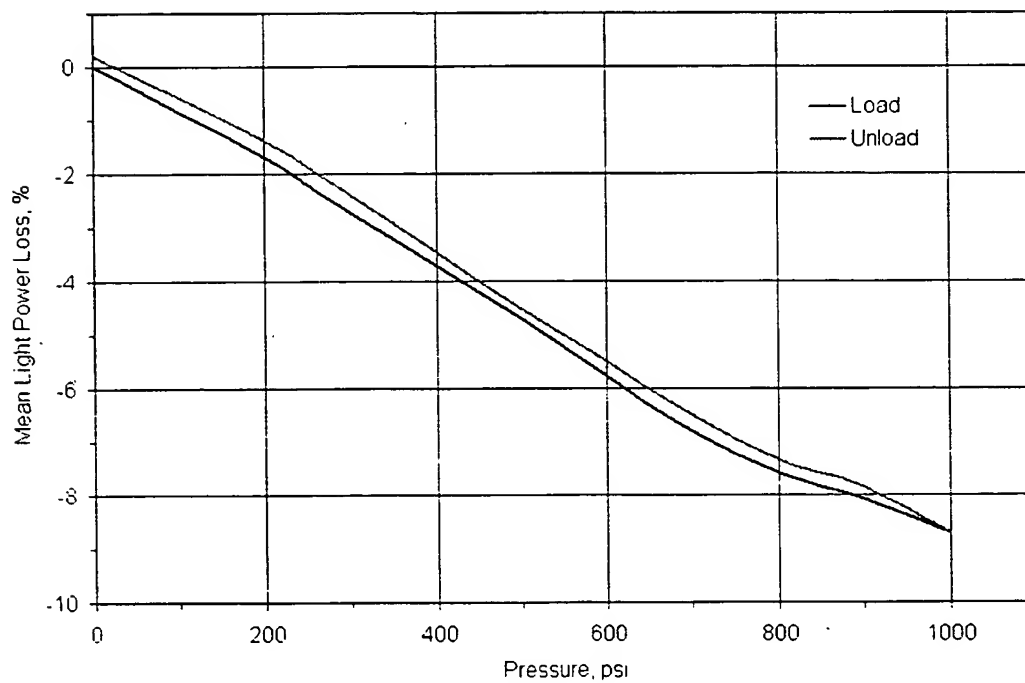
**Fig. 5-9. Tank 3 Light Power Loss**



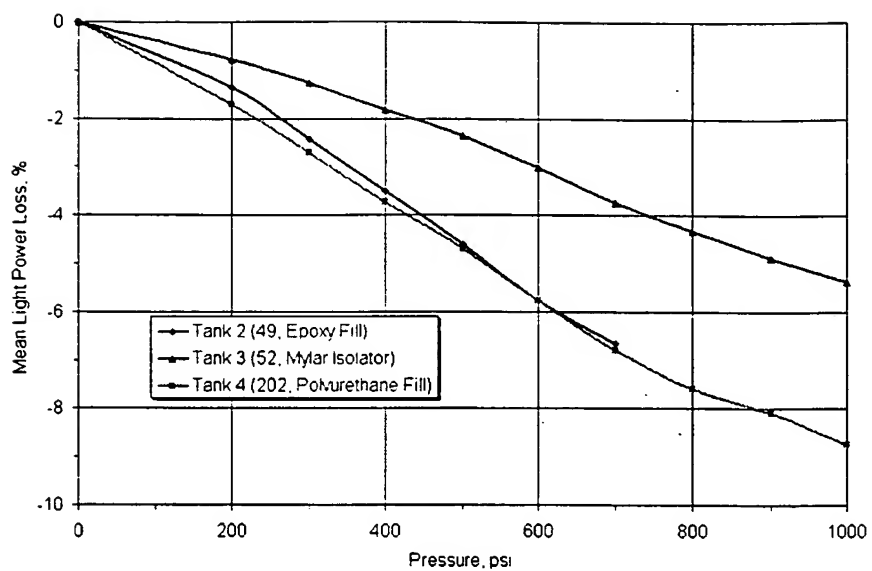
**Fig. 5-10. Tank 3 Mean Light Power Loss**



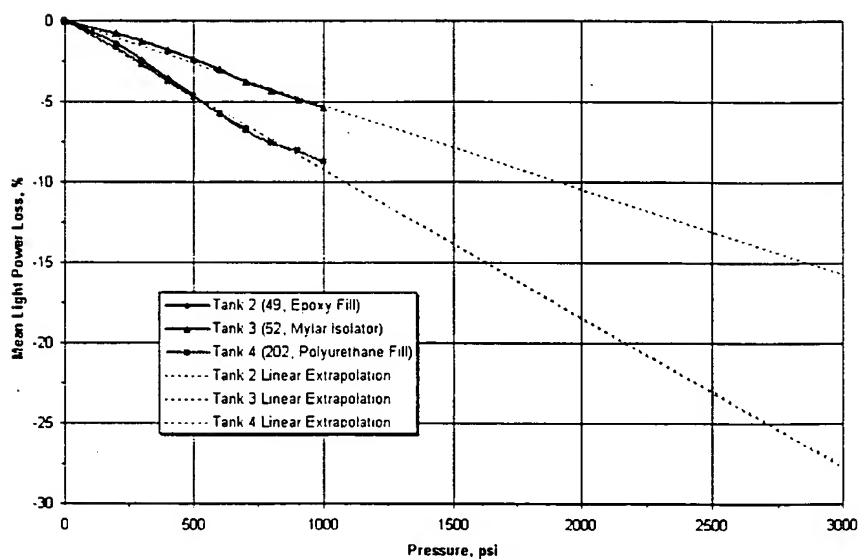
**Fig. 5-11. Tank 4 Light Power Loss**



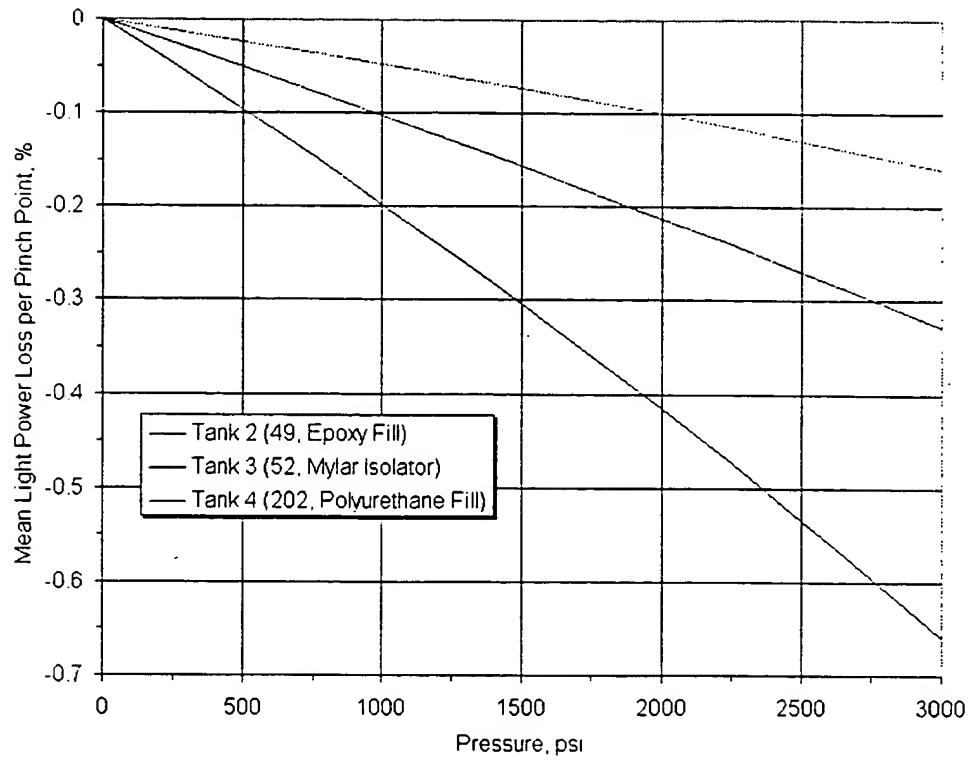
**Fig. 5-12. Tank 4 Mean Light Power Loss**



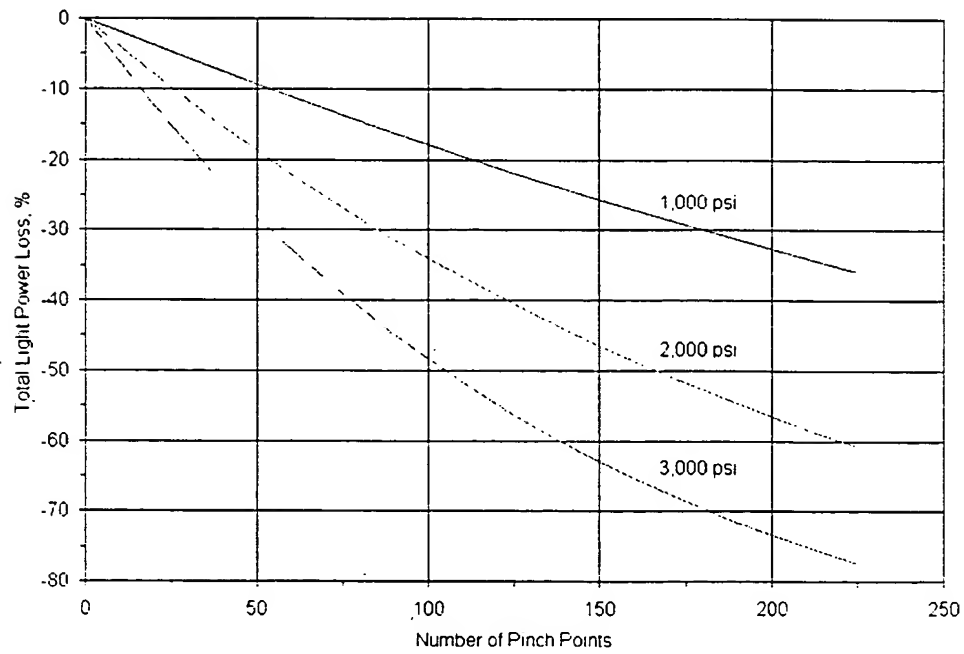
**Fig. 5-13. Tanks 2,3,4 Mean Light Power Loss vs. Pressure**



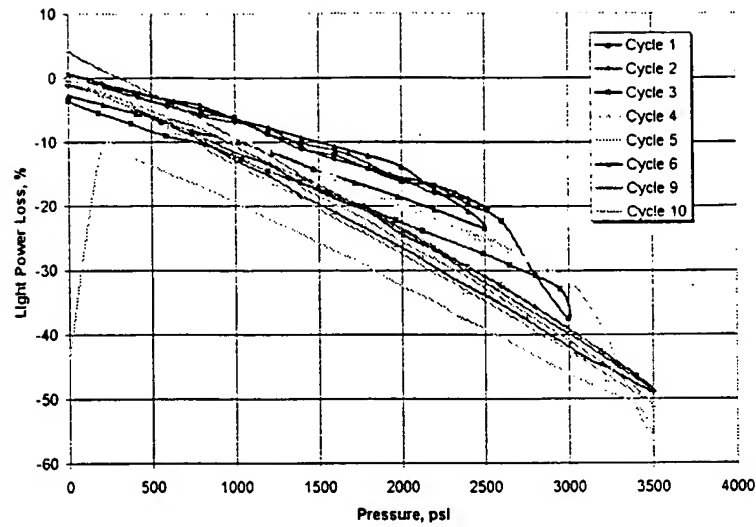
**Fig. 5-14. Tanks 2,3,4 Mean Light Power Loss**



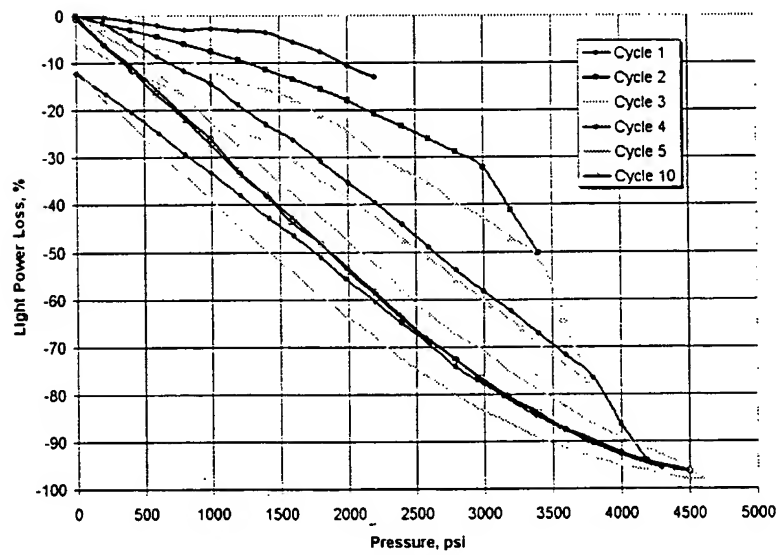
**Fig. 5-15. Tanks 2,3,4 Mean Light Power Loss per Pinch Point**



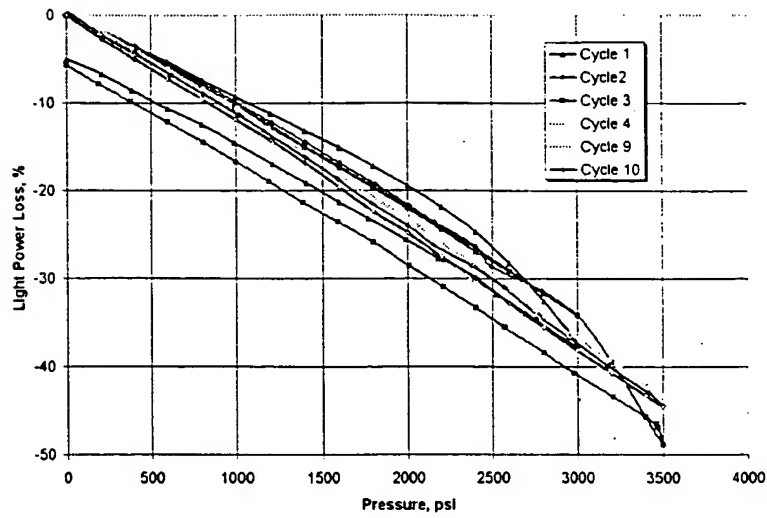
**Fig. 5-16. Tank 2 Light Power Loss vs. Number of Pinch Points**



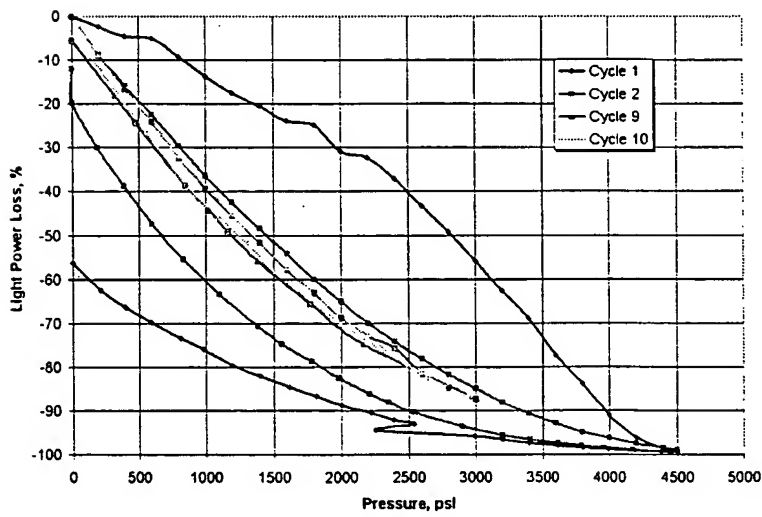
**Fig. 5-17. Tank 2 Light Power Loss**



**Fig. 5-18. Tank 3 Light Power Loss**

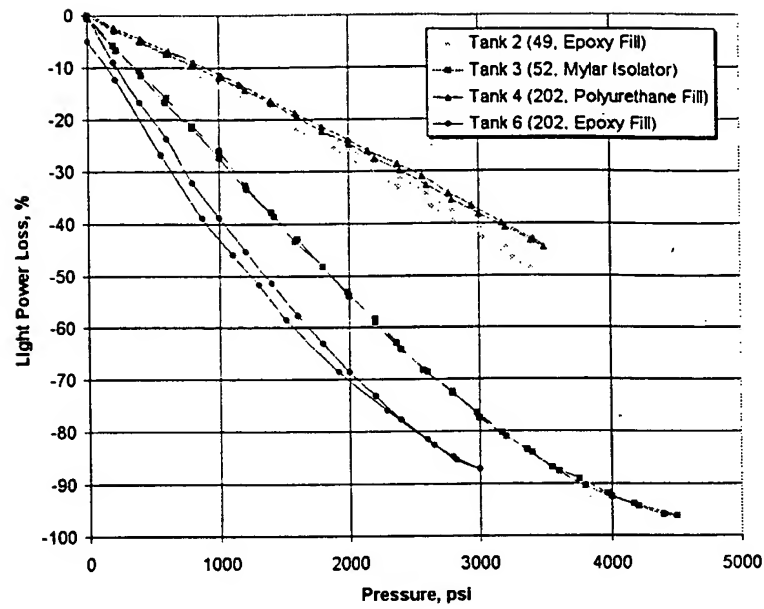


**Fig. 5-19. Tank 4 Light Power Loss**

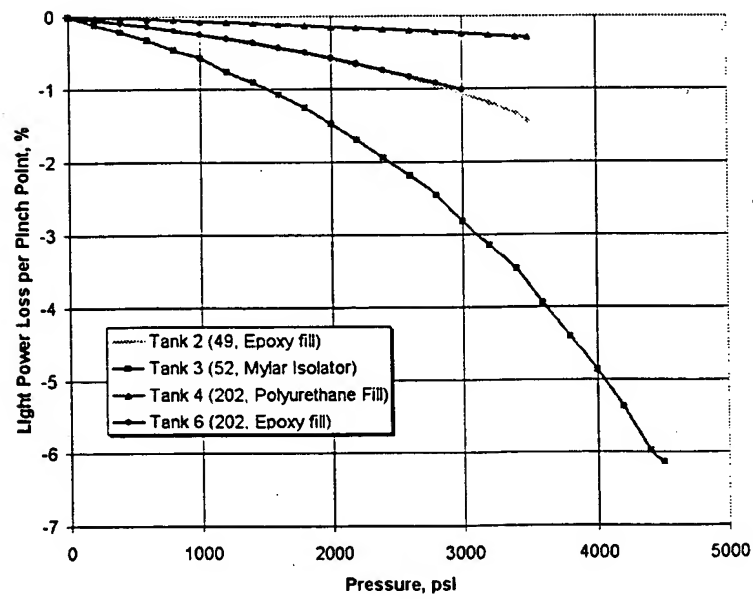


**Fig. 5-20. Tank 6 Light Power Loss**





**Fig. 5-21. Light Power Loss at Cycle 10**



**Fig. 5-22. Light Power Loss per Pinch Point at Cycle 10**

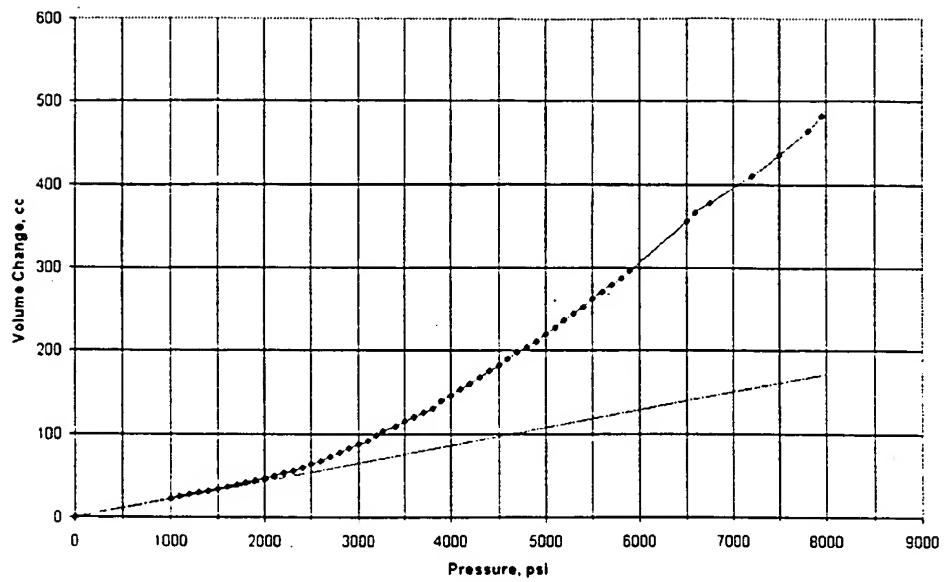


Fig. 5-23. Tank 1 Hydrostatic Test

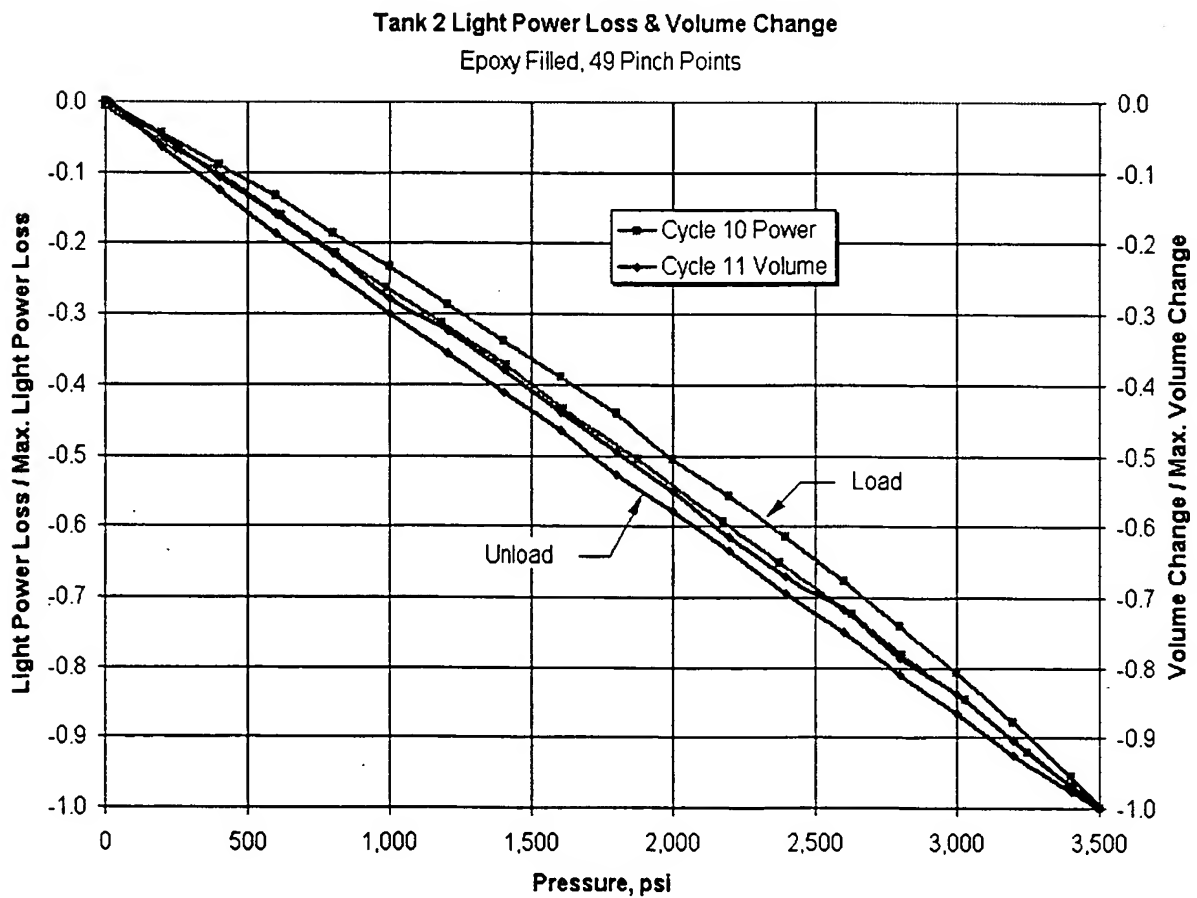
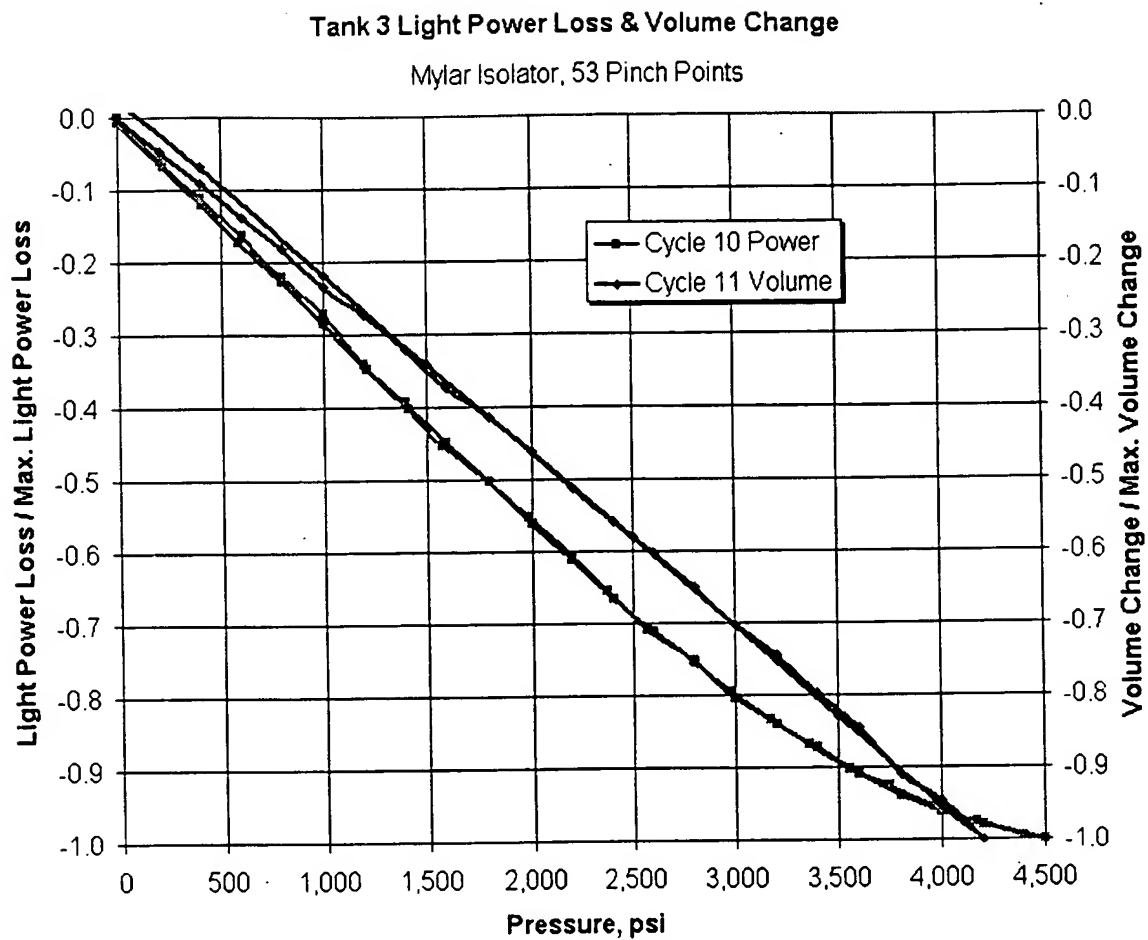


Fig. 5-24. Tank 2 Sensor Performance



**Fig. 5-25. Tank 3 Sensor Performance**

### Tank 4 Light Power Loss & Volume Change

Polyurethane Filled, 202 Pinch Points

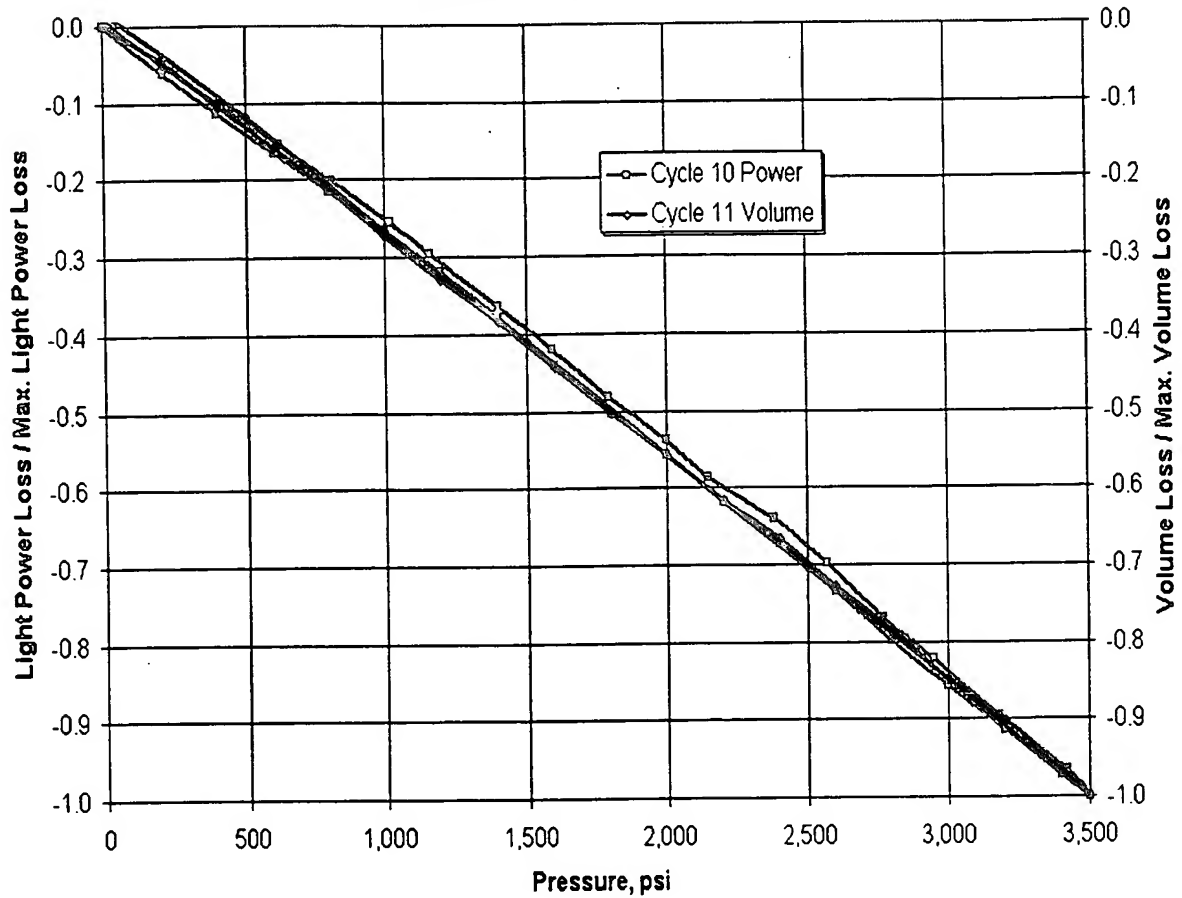
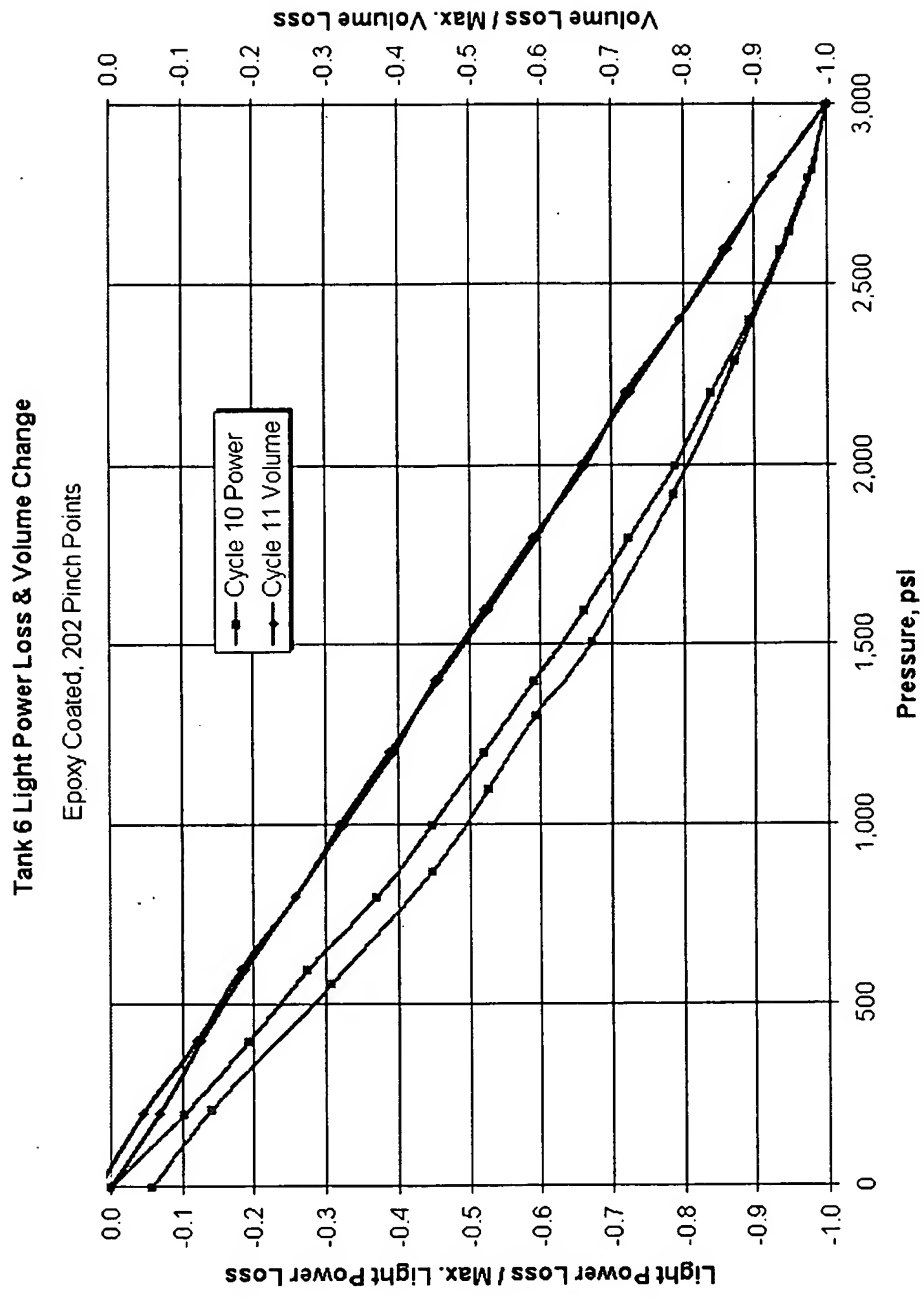


Fig. 5-26. Tank 4 Sensor Performance



**Fig. 5-27. Tank 6 Sensor Performance**